

American Chemical Society AMA: Hi Reddit, I'm Rigoberto Advincula and I want to talk about the nanotechnology in our everyday things: food packaging, pollutant sensors, paints, drugs, and more. AMA!

Rigoberto Advincula¹ and r/Science AMAs¹

¹Affiliation not available

April 17, 2023

Abstract

Hi Reddit! I am a Professor at Case Western Reserve University with the Department of Macromolecular Science and Engineering, a Polymer Professor for short! I also have joint appointments with Chemistry and Biomedical Engineering. For the last 18 years my focus has been in the discovery and engineering of materials, specifically nanomaterials, and find useful applications related to things like paints, composites, sensors, and packaging. This means that we need to first understand the synthesis and properties of these billionth of a meter particles or thin films. We have published numerous articles in scientific journals reporting their interesting properties and reporting methods of preparation. However, my group and I find interesting ways to apply them for practical and industrial purposes. For example, we have worked on high barrier coatings that enable better packaging materials to make food last longer, sensors that can be used to detect pollutants, dangerous substances, and drugs, and we have made materials that are useful for light emitting devices and solar cells. Most importantly, the group has turned out numerous students who have become independent researchers, professors, innovators, and in general good careers in looking a technology from the perspective of chemistry. For more information about me and my research, you can visit www.rcapoly.net. I serve as a journal editor in a number of high impact factor journal like Reactive and Functional Polymers, Polymer Reviews, and also as board members in Macromolecules, ACS Applied Materials and Interfaces, and Macromolecular Chemistry and Physics. I am the Chair of the Polymer Chemistry Division of the American Chemical Society and have been interested in advancing the science, the profession, and the community. I give regular webinars on Nanotechnology as sponsored by Park AFM Instruments. Recently, we established a consortium for bringing new materials technologies to the oil and gas industry. There is much promise for new developments and Nanotechnology has been at the forefront of many advances now in materials, although not as many “would like to admit it” as it seems to be still clouded mysteriously as a process. There is also a lot of misconception about it. Other than my other professional activities, I am interested in working with 3-D printing, entrepreneurship, mentoring young students, and helping the Philippines. I will be available at 1:00pm ET. Ask me anything about nanotechnology on everyday things and I will be happy to answer the state-of-the-art and the prospect for future applications. ET 1:00 PM, I am available online to answer any questions. RIgoberto Advincula I will answer the questions online on the order it was recieved. Rigoberto Advincula ET 2:30 PM, I will take a break for now and will try to answer more questions later. Rigoberto Advincula ET 9:30 PM I answered more questions. Rigoberto Advincula ET: 10:20 PM Sign off for now. Rigoberto Advincula

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AMERCHEMSOCIETYAMA [R/SCIENCE](#)

ABSTRACT

Hi Reddit!

I am a Professor at Case Western Reserve University with the Department of Macromolecular Science and Engineering, a Polymer Professor for short! I also have joint appointments with Chemistry and Biomedical Engineering.

For the last 18 years my focus has been in the discovery and engineering of materials, specifically nanomaterials, and find useful applications related to things like paints, composites, sensors, and packaging. This means that we need to first understand the synthesis and properties of these billionth of a meter particles or thin films. We have published numerous articles in scientific journals reporting their interesting properties and reporting methods of preparation. However, my group and I find interesting ways to apply them for practical and industrial purposes.

For example, we have worked on high barrier coatings that enable better packaging materials to make food last longer, sensors that can be used to detect pollutants, dangerous substances, and drugs, and we have made materials that are useful for light emitting devices and solar cells. Most importantly, the group has turned out numerous students who have become independent researchers, professors, innovators, and in general good careers in looking a technology from the perspective of chemistry.

For more information about me and my research, you can visit www.rcapoly.net.

I serve as a journal editor in a number of high impact factor journal like Reactive and Functional Polymers, Polymer Reviews, and also as board members in Macromolecules, ACS Applied Materials and Interfaces, and Macromolecular Chemistry and Physics. I am the Chair of the Polymer Chemistry Division of the American Chemical Society and have been interested in advancing the science, the profession, and the community. I give regular webinars on Nanotechnology as sponsored by [Park AFM Instruments](#).

Recently, we established a consortium for bringing new materials technologies to the oil and gas industry. There is much promise for new developments and Nanotechnology has been at the forefront of many advances now in materials, although not as many "would like to admit it" as it seems to be still clouded mysteriously as a process. There is also a lot of misconception about it. Other than my other professional activities, I am interested in working with 3-D printing, entrepreneurship, mentoring young students, and helping the Philippines.

I will be available at 1:00pm ET. Ask me anything about nanotechnology on everyday things and I will be happy to answer the state-of-the-art and the prospect for future applications.

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It seems that nanotechnology has been integrated all around us. But since I can't see it, what things do I interact with on a daily basis that utilizes nanotechnology?

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Try To Restart It

The simplest criteria for classifying nanotechnology is that of scale and phenomena. The scale of a billionth of a meter and phenomena that harnesses this scale is nanoscience and nanotechnology. The size of objects, particles, thickness, etc. are about 1 nm to 100 nm. But in general sub- micron. In principle there is nanoscience going on around us everyday. It is a matter of understanding and harnessing that towards understanding things or a particular application. The human body has many example. But all around us there are many examples. Maybe we can start with viruses - these are of the order of 30 nm to 100 nm in size. They can cause communicable human diseases or are even found in infected plants. In terms of commercial examples, nanosilica (filler particles) can be found in paint, rubber, and plastics. EDIT Rigoberto Advincula

Who is responsible for regulating the safety of nanotechnology that is currently in use or planned for use in our environment? Thanks.

Here is this blurb from the CDC: "Studies have indicated that low solubility nanoparticles are more toxic than larger particles on a mass for mass basis. There are strong indications that particle surface area and surface chemistry are responsible for observed responses in cell cultures and animals. Studies suggests that some nanoparticles can move from the respiratory system to other organs. Research is continuing to understand how these unique properties may lead to specific health effects."

<http://www.cdc.gov/niosh/topics/nanotech/>

AuricEnterprises

Eventually it will be FDA, EPA, and any advisory and regulatory body. Rigoberto Advincula

Thank you for doing an AMA! Due to the relative newness of nanotechnology there is a general lack of public knowledge about the complexities of the tech as well as an apparent lack of professional care for public health and safety. Nanoparticles can penetrate any part of the human anatomy and there has not been a lot done in the way of testing the long term health effects of nanotechnology. What are your thoughts on the relatively untested effects of nanotechnology on the human body?

Mister Johnson

Certainly, it will be of high interest to us to learn about any toxic, teratogenic, carcinogenic effects of nanoparticles. What this discussion can eventually lead to is drawing any parallel history or effect found in asbestos. Another is since they are in the scale of viruses, is there a correlation? One of the most studied nanoparticles are clay nanoparticles, So far most of it has appeared on the preparation of nanocomposite engineering plastics and in coatings. Possibly in terms of medical applications, there is a lot of interest in using gold nanoparticles for diagnostics including plant virus nanoparticles. There has been animal studies on these nanoparticles used for "theranostics" therapy + diagnostics. So far they have not shown any harmful effects. Gold is quite inert and unreactive chemically. The main concern is by reducing it to the nm scale size, do they become more reactive? Nanoscale is one order higher than atoms and molecules. Separated polymers in solutions are large molecules or macromolecules. They can be considered nanoscale materials since they can be of the order of 1 to few nms in size. For example, we have studied a lot large macromolecules called dendrimers. 1- 5 nm in size. they are used also for drug delivery or diagnostic applications in animal studies. So far no harmful effects reported.

EDIT Rigoberto Advincula

What is the biggest technological bottleneck or challenge to implementing nanotechnology right now? Is it providing power to each particle? Creating software capable of coordinating them? Is it Politics?In other words, what's the largest hurdle we have to overcome? What about

the second largest?

Thanks for doing this!!

[tastemytrident](#)

The biggest hurdle for applications of nanotechnology is both regulations and cost. Certainly in terms of generally improving the properties and performance of certain products like coatings, engineering plastics, and effectiveness of delivery (drugs, nutraceuticals), the applications of nanotechnology is in place. This can be in the form of more dispersed filler materials, oriented processing, and also use of phenomena based on colloids, micelles, and liposomes. The phenomena and process is there, and it is just not labelled as nanotechnology. In terms of cost, the pure material is expensive. But the formulated, solution, or master batched material is less expensive since it is dispersed in a medium.
Rigoberto Advincula

What about the risks? We learned about asbestos fibers and that they damage soft tissue and can't be transported by white cells ([this image shows why - it's like using a sponge to remove a spear](#)) . When asbestos was invented everybody was excited about the many great uses for this new material. Now we have to destroy houses build with asbestos since it makes people sick over time and eventually kills them (Approximately 100,000 people in the United States have died, or are terminally ill, from asbestos exposure related to ship building).

Are you also concerned and checking for possible problems of nanotech for the human body? What happens when nano structures break up and enter the blood stream or get inhaled?

[Nachteule](#)

Good point on asbestos and one can include of course concerns with lead or other heavy metals in the environment. The safety issue is if it is going to be commercially and widely used, will we find some harmful effects further down the road? One way to start is on how nanomaterials are handled. The safest way to handle these materials is in terms of solutions, formulations, and master batches. You can imagine if it is handled as a powder, how much dust it can create. Asbestos problems are usually associated with lung diseases. Like breathing polluted air in cities and near industrial plants, one can suppose that packaged dust and pollutant particles are equally culprits in lung diseases as nanoparticles in air. So there are no easy answers and genetically some are more prone to diseases caused by these nanoparticulate problem. The way to address this scientifically is to develop standards for testing including high throughput methods to screen nanomaterials and their various forms.
Rigoberto Advincula

superhydrophobic stuff. Those things with the the awesome videos of mud splashed onto a white suit... stays clean, or concrete blocks where the water forms square puddles that behave like mercury.

what's the downside?

[Lastonk](#)

I think the comment below does address some of these weaknesses in the superhydrophobic effect. Actually if I may add, a superoleophobic effect is equally useful (imagine smudge free Iphone!). So an ideal coating that can resist most fouling problems will be superhydrophobic and superoleophobic effect combined. Then how to make it last longer.
Rigoberto Advincula

Once nanotechnology allows for self-replication ('nanobots'), how seriously should we take the risk of 'grey goo'?

If it's not a risk, why not? It seems plausible enough to the uneducated (myself!) once you figure the self-replicating part out. What simple thing am I missing that makes you chuckle at

such an insane worry?

[sarcastr0ll](#)

Self-replicating nanomaterials or nanobots have been discussed and hyped and I am also waiting for a real demonstration. Rigoberto Advincula.

Hello Professor,

Current undergrad chemistry major here with a few questions

Where do you think nanotechnology will have a bigger impact first; in our technology (i.e. microprocessors, better insulation devices, better battery cells and device sensitivities) or in the health field (i.e. implants, medicine, etc.)?

My second question is, being as new as nanotechnology is, what are the inherent challenges in studying such materials? In a normal lab like mine, most of the instrumentation needed for study is "readily" available. Are there challenges in the analytical aspect of nanotechnology, where traditional analytical methods have not yet caught up? How difficult or viable is producing enough of a nano-material where there is sufficient amount to study it in the first place?

Best, bsbl14lfe123

edit*: spelling

[bsbl14lfe123](#)

Best to be in a lab where you can both synthesize nanomaterials or fabricate them and also analyze them. Understanding the dispersion, size-scale, and their eventual properties allow you to appreciate their advantages or discover new phenomena. Rigoberto Advincula

Hello professor Advincula!

I just started my path toward Chemical Engineering and I am hoping to land somewhere in Battery research as that is something I'm passionate about and a huge hole we have yet to address.

So my question is, do any of the nanomaterials you or your team have engineered have any applicability toward battery improvement? if so, anything exiting you could share with us?

[Abandon-All-Hope](#)

Yes, these should be in terms of electrodes, catalysis, and also transport (electrons, and ions). There is a lot of interest on graphene based nanomaterials for batteries. Another working on ultrathin film dielectric materials and super capacitors. Also check on thermoelectrics. Rigoberto Advincula

How do you typically go about finding new polymer structures that fit your applications?

[ilikegiraffes123](#)

Polymers can start from their synthesis from specific monomers or well-known polymers in which their MW, polydispersity, and structure can be modified. Sometimes we employ copolymers (2 or more monomers) or blends (mixtures). If you are familiar with structure-property or structure-composition-property relationships, it is possible to derive their targeted application. But this may not be straightforward in terms of new polymers. Applications can range from thermo-mechanical, chemical, and optical applications. Rigoberto Advincula

Hi! I'm looking into alternate solar technologies as part of my thesis. What kind of new solar

technology is on the forefront?

[stumpagness](#)

Everybody is talking about perovskites these days. Rigoberto Advincula

You mention that various nanotechnology sensors are used on food and detecting drugs, but how has nanotechnology impacted the diagnostic area of medicine?

Thank you for doing this AMA

[Lightupthenight](#)

In the area of medicine, there are several possibilities. The use of gold nanoparticles (other metal or inorganic nanoparticles), viruses, dendrimers, and liposomes, have been reported for effectiveness in drug delivery and diagnostic applications. As a sensor, these nanomaterials can be simply be labelled with biomarkers or chemical functional groups that can capture and detect chemical species or analytes or affixed on cancerous cells or tissues. Their ability to be detected with a specific spectroscopic signature or even deliver a payload drug makes them unique in that they have both therapeutic and diagnostic (theranostic) application. Rigoberto Advincula

What new or upcoming nanotech are you most excited about?

[men_like_me](#)

I am most excited about graphene nanomaterials as many of my colleagues are. I have worked on clay nanoparticles and carbon nanotubes for a while. The graphene nanomaterials seem to have many uses from electronic to diffusion barrier applications. They are also readily accessible. We have reported uniquely their anti-microbial properties. Rigoberto Advincula

As someone looking to get into bioethics as a lawyer (just going to law school this fall), I'm thinking I should look towards IP in this field (particularly with nanoscale tech, as my law school has ties to a particular nanoscale science and engineering college). Do you have any advice for someone in my position who is looking to get into this field as a lawyer - it's incredibly interesting.

Also, what do you think are the pertinent bioethical issues that will arise in the coming future? And, do you think there are any other really interesting fields for bioethics or IP that the layman may not yet know about?

[BrownEyeBattlecry](#)

Most likely, of high interest certainly is the ability to understand their crucial role in any new technology that is patented. Nanoscale processing or formulation eventually is about surface/volume ratio advantage as well as the creation of unique structure (nanostructures) that cannot be found in another scale. Bioethics, I am not sure how much it can play a role, although it is possible if the use of nanotechnology can eventually be of harm to humans. Rigoberto Advincula

There is a lot of "nano-technology" and "polymers" talk surrounding car care products, such as surface protectants ("waxes" and sealants).

Any insight as to what it fundamentally means to employ "nano technology" and or "polymers" and how to cut through marketing nonsense?

For example: <http://www.autogeek.net/wg5500.html>

"Wolfgang Deep Gloss Paint Sealant 3.0 was developed in order to meet the demand for a paint protectant that captures the wet look of a carnauba wax but lasts longer. Immediately, we

looked to the newest breed of crystalline "super" polymers being developed in Germany. German Super Polymers were the foundation of our original groundbreaking formula."

[Geriatric05](#)

Quite possibly, they are citing studies or the fact that some of their additive ingredients or dispersions (emulsions) of waxes have structures of the nanoscale order that renders the coatings or sealants to be more long-lasting in terms of environmental stresses. It is easy to claim but if one is really interested, this has to be verified by empirical evidence. Rigoberto Advincula

With your knowledge of chemistry and biology, as well as your opinions on life (and what that means), can you envision the possibility of us creating life (or something that resembles it) at the nano scale?

And here's a bit of a stretch question (if that one wasn't already a stretch): If we end up being able to replicate the pattern of the human mind in software (a trimmed down version) and make that software very efficient, can you image if humans were able to live on nano scales? Obviously, we'd need a newly designed body to account for the physics at that level, but what about the mind? Are there any limitations at those scales that make this kind of idea impossible?

[Netherfap](#)

Not so much on the philosophy of things. But the closest we can associate nanobots, nanomachines, are with viruses, muscle cells, and the way DNA is assembled or replicated. At that nanoscale, the idea will be to create some artificial or synthetic and self-replicating equivalent. I have not seen one yet. Rigoberto Advincula

Two years ago, I managed to be in a lecture about nanotechnology. The professor predicted nanotechnology to experience a huge boom in the next 20 - 40 years. A boom similar to the computer one. Do you think that nanotechnology will experience such an expansion? Since I am not completely sure about my future career, is nanotechnology one of those sectors to go for and one of those sectors which offer the most space for a major breakthrough or technological advancements?

[Curudril](#)

I believe many companies are employing nanotechnology or improved processes and additive materials that take advantage of this phenomena. They are either not ready to report it or has kept it us trade secrets. I think more breakthroughs are coming if it becomes as widely accepted as a process in manufacturing. So you can google nanomanufacturing. Rigoberto Advincula

I'm starting my PhD in materials science this September. Any advice for me?

ONE more question: What areas of materials science will be hot in a few years but don't get much attention now?

[c0smic_Owl](#)

It is good to focus on polymer materials although in general metals, metal oxide, alloys, and ceramics is good. From these fundamental classes you can branch out to applications in aerospace, semiconductors, biomedical, and of course plastics, rubber, and coatings. It is what you want to pursue and the Professor whom you would like to work with. Bioinspired nanomaterials are always of high interest. Rigoberto Advincula

One of the big issues in chemistry (including nano) is that we have much difficulty developing materials with a specific function. Sure, we can just about synthesize anything we can possibly

imagine structurally but we cannot synthesize something easily that serves a particular predetermined function. How do you think this will improve in the near future?

[testingTheBits](#)

The key is to understand structure-property or structure-composition-property relationships. If you know a specific and desired property you can start by design then work out a process to make it. In terms of formulations or monolithic materials, the fabrication of a film or an object will determine its eventual application. Anyway, these things do come with knowledge and experience. It also helps to listen to industry needs. Rigoberto Advincula

Morning! You mentioned advances in the gas and oil industry, but as these are becoming more archaic industries, id like to know: How will nanomaterials start to affect the much needed switch to greener energies?

[TeMpoSlash](#)

Good question. There are more problems in the oil-gas industry than there are solutions. Examples of applications: nanocomposite materials used in various polymer parts (non-metallics) found in drilling tools, Blow-out preventers, packers, that result in improved thermomechanical and chemical stability. Another is in terms of nanomaterials used as additives in drilling fluids (fluid loss agents) and also in completion fluids (effective delivery of other additives. And more. Rigoberto Advincula

How do you build anything at the nano level?

[RosDaddy876](#)

Two directions: bottom-up and top-bottom. The first is that you need nanoscale building blocks and the ability to order them by self- or directed- assembly. The latter, is by lithography or even milling all the way to the nano level. Rigoberto Advincula.

Dr. Advincula,

I am an undergraduate chemical engineering student working in a research lab studying admicellar polymerization. I am such a fan of your research! My question is: If you could go back and do it all again, would you choose polymers again? Why?

Edit: Spelling

[Hisplan](#)

I got fascinated early on with liquid crystals and this was in the 1980's. That is when I realized that polymers are found everywhere including the biggest chemical industry. I think I would still have chosen polymers and this has certainly opened for me many doors and long-lasting friendships! Rigoberto Advincula

Thanks for doing this AMA! You seem like a pretty busy guy to say the least, so we appreciate it.

Anyways, I'll get to my question. Last year I gave a speech on how bee venom wrapped in nanotech could be delivered to a cancer site and destroy cancer cells by starting apoptosis. Due to the limits of my speaking time, I couldn't get in to the specifics about HOW the nanotech knew to get specifically to the cancer cells. Even when I did a research paper for cell bio, I couldn't find much information on how exactly nanotech "knows" where to go in the body. Is it looking for a specific sequence of amino acids, or base pairs in DNA, or what? Basically, when does the nanotech "know" it's in the right spot to deliver such medicine? I know you don't specifically deal with the medical side of things, but I figured this might be a basic nanotech idea that is going over my head.

For those curious, my speech and research paper were based off of Dr. Dipanjan Pan's work at the University of Illinois.

[AwkwardStyle](#)

It starts with the concept of theranostics. If you can have the nanoparticle act as a biomarker and interact or intercept with the malignant cell or site, then that is the first step. The second is that the payload drug can either affect the cell replication and protein production (either the genomic or proteomic approach). So these can be in the form of Si-RNA, aptamers, or specific chemicals (associated with venoms) that can destroy protein sequences specifically. Rigoberto Advincula.

Any applications of nanotech in agriculture (on the technological side, not the gene side)?

[dumnezero](#)

Perhaps in improved seed coatings. Also in terms of delivery of pesticides and fertilizers in improved formulations. Rigoberto Advincula

Hello, thanks for doing this AMA. Some sci-fi series (Wool etc) talks about nanotechnology in the sense that nano-sized robots can be programmed to do pretty much anything, repair or destroy cell structures and that all future warfare is gonna be waged on the nanoscale. I know that sci-fi is called sci-fi for a reason, but sometimes the authors hits close to home. Do you think this is something that could happen in the future and what are your thoughts on this?

[Summerpirate](#)

Perhaps, but I have yet to see any empirical evidence that they can be made or self-replicate. It may be closer to look at NEMS devices (nano electro mechanical systems). Rigoberto Advincula

I have been told on several occasion that researchers have taken silver in a nano-sized format and used a special electro-static sprayer to apply to it any surface. Once the surface dries, it will keep the surface germ free. Could you elaborate on if this is real and when we might see it used in places like a hospital.

[Bkeeneme](#)

Yes, Silver nanoparticles and even Copper have been used for anti-microbial functions. We are in particular excited about using graphene/graphene oxide nanoparticles instead of silver. Rigoberto Advincula.

Hey Professor Advincula, welcome to Reddit!

My question for you is, as a student very interested in nanotechnology (especially as it applies to alternative energies), what can I do to pursue a career in a nanotech field?

Thank you!

[ElegantRedditQuotes](#)

Nanotechnology- nanostructured films, patterns, and nanoparticles can eventually contribute to an increase in efficiency in electron/ion transport and catalysis. So with solar - photovoltaic or fuel cell functions, it can have an improvement effect. Watch out how you can apply this knowledge to increase efficiency in these processes. Rigoberto Advincula.

Hi Dr.Advincula. What do you think is the greatest advance in nanotechnology yet?Also, what advice would you give to a student aspiring to do a PhD in Nano-biotechnology.Thank you

[sas624](#)

I think great advances are yet to be implemented in curing diseases or at least helping the body cure diseases. Focus on theranostic applications. I am doing some work together with a collaborator Nicole Steinmetz on plant viruses for theranostic applications. Rigoberto Advincula

Hi Prof. Advincula,

Just over 50 years ago Richard Feynman gave a lecture titled [There's Plenty of Room at the Bottom](#). How far would you say the science of manipulating molecules at the atomic or nano-scale has advanced since then? Are we anywhere near the point that we can "3-D print" molecules according to our needs? What areas do you think require the most innovating right now, in the process of getting to this goal?

[krsparmsg](#)

Yes, this is a visionary lecture as is classical Feynman. We may not be far from more nanoscale applications. Perhaps, a true high value-added and widely used commercial driver. But certainly the journey for most of us scientists and engineers involved in doing this research has been exciting along with the careers of students who graduated from our labs. Rigoberto Advincula.

Hi Dr. Advincula. Thanks for sharing your time with us!

I've long been interested in the engineering of biological cells toward nanotechnology, in particular protein engineering. I'm wondering how much this field affects your work.

Do you use engineered cells in your development pipelines? What breakthroughs in cell engineering would make them most useful to you?

[discofreak](#)

I collaborate with Dr. Nicole Steinmetz. She is an expert in virology. In particular, she can use genomics to engineering particular plant viruses for drug delivery and diagnostics. We are looking at theranostic applications. Another is of course incorporating specific ligands and functions in gold nanoparticles. I am interested these days on graphene derivatives. Rigoberto Advincula.

Hi Dr. Advincula, I have been noticing an increasing impact factor growth for ACS Applied Materials and Interfaces do you expect this growth to continue? Is there a particular direction the journal is being taken in and do you have any recommendations for submitting papers to the journal.

Side note, will you be attending the ACS conference in Boston next week?

Thank you for your time.

[Pompousasfuck](#)

I will be in Boston ACS next week. I love this journal, ACS Applied Materials and Interfaces. It just shows that this is a wide area of focus in science and engineering and the journal is able to connect with practical applications of interfaces and thin films. Rigoberto Advincula

Thanks for doing this AMA! I'm a Biochemistry student and have always been fascinated with the direction nanotech is going. I've done a lot of literature research on nanomedicine and have found quite the development of anti-tumor (+ more!) "Theranostic" nanoparticles.

Where do you personally think this type of drug delivery systems are headed and when do you think they will be available to the public health care system?

[LiQuiD0v3rkiLL](#)

I think, for now a lot of uses are coming from liposome technologies. Although, what I would like to

closely develop are related to dendrimers, gold nanoparticles, and plant viruses. Rigoberto Advincula

What are the potential applications of polymer or block polymer thin films? Do you see promise in these materials/do you have experience with them?

Thanks!

[observer010](#)

Interest in stimuli-responsive (smart coatings), optical effects, and also sensors. Rigoberto Advincula

Are there any applications of nano technology being used to make new materials joining processes (eg Welding, fasteners, adhesives, etc)?

[RallyWeld](#)

Most likely in welding and adhesives. For metals, understanding the alloying process and ability to control crystallinity in grains and domains. For adhesives, it will be the inclusion of nanofiller materials that can improve adhesive strength (or even flexibility) and their long-term properties. Rigoberto Advincula

What is the biggest challenge to bringing nano-technology as a method of delivery for antimicrobials, and other pharmaceuticals? I've heard of lots of research being done, but I have yet to really see it out used in practice.

[JimmyRoseMiroAlDey](#)

The best is to do very targeted delivery and even diagnostic function. A theranostic design or application is the best combination for anti-microbials and pharmaceuticals. Rigoberto Advincula

What is the most exciting thing (in your opinion) that this research/product will be applied to one day?

[ClayTaylorNC](#)

It will be good to find a cure for cancer through nanotechnology.

Thank you for doing this AMA! The world should be educated about nanotechnology before the vocal scientific illiterates make the public afraid of it (like what happened with fission power and is happening with GMO foods now).

Non-technical question: Have you find that the general level of scientific illiteracy has affected your work, and if so then how?

Technical question: Does your work center more around self-assembling nano particle structures, directed-assembly nano particle structures, or is it more involved with thin film exploration? Also, what is your favorite nano structure, and why?

Thanks!!

[positive_electron42](#)

Yes, I agree. We should advocate scientific literacy. I am a supporter of media with PBS, Discovery Channel, How things work? etc. So the more the public appreciates science the better it is for us.

I am interested in directed assembly - nanostructuring by layering or grafting for example. It will be good to find cases for self-assembly whenever possible. Rigoberto Advincula

What application of nanotechnology are you most excited for in the coming years?

[therealdrago](#)

I can included here nanomaterials derived from animal and plant sources. I am interested in nanocellulose - nanofibers and nanowhiskers. But for now , we have a lot of effort on graphene based nanomaterials. Rigoberto Advincula.

Thanks for this AMA! Fascinating topic! I read an article (can't recall the source) that stated that as material is reduced to nano-sized particles, the properties of those materials change on a molecular level. The example given was, IIRC, an iron sample that changed color when reduced to nano size. Given that cursory information, it seems that nano tech can open up many benefits as being advertised. Do we have a grasp on the risks, and if so, who evalutes the risks?

[SkidMarkTwain](#)

Yes, fascinating in terms of changes in optical and even catalytic properties with reduction to nanoscale. The risks are that what is normally inert at the macroscopic scale are harmful at the nanoscale. This has to be evaluated with standardized testing methods and reported and repeatedly verified before it becomes a standard test or label. So lots of work still - but not prejudice a technology because of the hype. Rigoberto Advincula

Hi Professor,

Thank you for doing this AMA. I'm currently a Nanoengineering undergrad and I'm looking forward to this ama. My questions are:

- **I see you are an editor for a number of journals, what other journals would you recommend that an undergrad like myself to read to familiarize ourselves with the field?**
- **Aside from your own research, what other research in nanotech is most exciting to you?**
- **What other universities (domestically and abroad) do you thinking are doing exciting things in Nano?**

Thank you very much!

[planksconstan](#)

Interesting journals are Advanced Materials, ACS Nano, Nanoscale, Nanoscience, surely Science and Nature. Soft Matter, Chem Comm and ACS Applied Materials and Interfaces. For research, check on naturally derived nanomaterials like nanocellulose. Universities - many to name but go for individual professors. Rigoberto Advincula

In your opinion which sector will be the next to start making regular use of nanotechnology?

[ClosetedGayBro](#)

It will be in the coatings and plastics industry. Rigoberto Advincula

As a chemist working on innovating useful products, as compared to other fields of science, do you find that you have more opportunities to exercise creativity in your work?

Also, it seems that the application of chemistry and nanotechnology are far-reaching. How do you actually work across such diverse fields of knowledge?

Thank you!

[Motherofcurry](#)

Chemistry is a fundamental and natural science to begin with. It sets you up to explore the relationship of things and to understand the physical laws that govern all around you. Chemistry has enabled me to be creative by applying it in problem solving and in understanding new phenomena. This in turn gives me a stable platform to innovate by combining other fields that I encounter. Rigoberto Advincula

Hi Rigoberto

I'm currently studying engineering and plan to master in nanoscience and technology at the catholic university of Leuven and I heard that it's difficult to find a job in nanotechnology is that true? And do you have any tips for courses I should take in my master of nanoscience?

[kuikske](#)

My suggestion is you focus on a course that is related to materials (metallurgical, polymer or ceramic) or chemical engineering. Then do research or take courses in nanotechnology. The function of getting a job is not necessarily with the degree but the experience and attitude to work in industry related challenges. If you like academia, you can have much gain in knowledge that eventually becomes a platform for industry. Rigoberto Advincula

I know close to nothing about nanotechnology so forgive my ignorance. I work in the beverage industry and am a firm believer that functional beverages are the way of the future. I was once told that an entire week's worth of nutrients can fit into a cup of water using nanotechnology. Is this possible and is there an application?

[booyakajones](#)

Interesting, if food technology can harness nanotechnology to improve or preserve flavors. There may be advantages in delivery of nutraceuticals. I will keep that in mind. The main advantage can be surface to volume ratio and controlled or efficient delivery. There is of course concern or fear in actual food consumption. But hopefully there will be enough positive correlation. Rigoberto Advincula

Good morning / afternoon Professor,

As a fan of Star Trek, I often wonder how possible it will be to have a cure for diseases like those expressed in science fiction. For example: there is a technology in which nanobots are injected into a patient's bloodstream that can detect diseased cells, attach themselves to said cells, and cure the disease one cell at a time. Are we even close to such an achievement within the next 3 generations? Thank you!

[redshirt99](#)

Maybe a possibility but there will be attempts to this I am sure as we all have been inspired by science fiction in one way or another. Rigoberto Advincula

Hi

What are your thoughts on how to balance emphasizing the need of proper risk management - like research on the effects of different NPs on the human body and the environment on the one hand, with preventing to cause exaggerates fears in less scientifically educated people (who also are afraid of "genes" in the food etc.)?

[Essiggurkerl](#)

Good point. Everything is based on risk analysis and sometimes cost/performance ratio. Statistical methods and algorithms can be used to make value judgement. If it can save many lives vs being harmful to a few it is worth a shot. Rigoberto Advincula.

You mention that you're interested in 3D printing, in what ways can 3D printing and nanotechnology combine? What would be the advantages and what should we be excited for? Thanks!

[TheInvincibleMan](#)

Nanocomposites that are 3D printed. They can have interesting advantages in terms of thermo-mechanical properties. Surface treatment of 3-D printed materials to convert them to a specific wetting condition. There are additive lithography methods that go closer to micron scale and perhaps eventually through further nanoscale treatment can have advantages in function. Rigoberto Advincula

Hope you're having a good morning. Thanks for the AMA.

Recently, I have been eating fast food occasionally like Taco Bell or Subway.

I noticed, the last two things I received from locations like these, the lettuce had a noticeable shampoo-chemical-like taste and scent.

Might be the wrong person to ask, but what is the common factor here? Residue from packaging? Preservatives?

[redditpentester](#)

Most like packaging or part of a preservative. I am sure it is FDA approved. Rigoberto Advincula.

I am going to college for a career in scientific/biomedical visualization. Do you think I'll have a chance to create media for medical nanotechnology in my lifetime? (I'm 25)

[balloon-loser](#)

Perhaps. First go for a degree that will enable you to get a good compensation, then hopefully combine it with your interests. Seems like you are interested in bio-imaging or some form of computation/simulation expertise. Rigoberto Advincula.

Hello Professor Advincula,

Do you first make the material, then think of possible applications? Do you ever engineer materials for a predetermined purpose?

Thank you for your time!

[holdencaufield](#)

I do both. I start with an interesting material that eventually finds some interesting uses. On the other hand, I have been requested by industry to develop materials or methods for a particular application. Rigoberto Advincula

From my understanding, there is growing concern over genotoxicity issues related to nanoparticles, even biodegradable ones. What are the reasons for genotoxicity, and will there be a large market in the future for providing genotoxicity related screening services for nanoparticles?

[NeuNAC](#)

Yes, it will be good to find a high throughput screening and standardized method. Rigoberto Advincula.

I'm an undergraduate chemistry student entering my junior year of university! What advice do you have for chemistry students like myself?

[PonyBoyCurtis2324](#)

Work hard, get your hands with research experience, intern with an active research group. Network and keep things exciting. Your success is proportional to the amount of time you work on things day-to-day. Rigoberto Advincula

How can nanotechnology improve athletic wear in order to give athletes an edge? Are there examples of that currently available to the public?

[mrclimacool](#)

I have seen some claims on tennis racket, tennis balls, baseball bat, clothing, and rubber shoes. One can of course google these and find out how the company is doing in sales. Rigoberto Advincula.

I'm always hearing that graphene is the nanomaterial of the future, and that we will soon be having a breakthrough in graphene technology all around us. How close is this to actually happening?

[AlethriionsThird](#)

A lot of interest and also a lot of knowledge built up in such a short time. I am convinced that it will become mainstream. Rigoberto Advincula

I worked in nanotechnology in "game changing" tech such as DLC thin films and superhydrophobic particles in paints and bulk resins.

Where do you think the most nanotech is being used today, passive additives or novel applications? Such as, particles to increase resin toughness versus superhydrophobicity.

I've seen some products that use particles but I wonder if they are in use now and just not being advertised.

[thepeter](#)

Good and I think you are on the right track. Rigoberto Advincula

What sort of techniques do you use to identify the reactions and/or products?

Also your field seems so broad. Is there a particular part you focus on more (paint, food, oil/gas, ect)?

[Cainga](#)

Spectroscopic, microscopic, and sometimes it involves some sample preparation or sample breakdown to understand the material. Reverse engineering can be applied with more complex formulations. Rigoberto Advincula.

Hi, thank you very much for doing this AMA!

I am planning on studying nanotechnology in Germany. I am a bit scared that I'll have problem to find a job after I graduated, since:

a) nanotechnology study courses are relatively new and maybe not that well established

b) they are very broad, teaching you a lot from many different fields like chemistry, physics and biology, while being very specific at the same time (limiting you only on the small scale part of those fields). I hope I expressed what I mean in a way you understand. Basically I fear that the industry will have a very limited use for my skills and may prefer someone who studied chemistry or physics and specialized in this area.

Could you maybe take away some of my fears or at least confirm them, so that I can try to counteract? I would be really interested to hear about the mentioned points from someone who is well established in this area.

[I haet typos](#)

Get a degree in chemistry, chemical engineering or traditional degrees and do research related to nanotechnology. You will be grounded in basics and yet specialized or serve your interest in an exciting field like nanotechnology. Rigoberto Advincula

How close are we to have commercially available organic solar cells? Are 10 years + lifetimes ever achievable for such materials?

[MRadar](#)

Hopefully sooner. It is a matter of efficiency and cost. Rigoberto Advincula

Hello! Thanks for the AMA. So in your description you mention that nanoparticles can be used as pollutant sensors. What about the nanoparticles that are actually pollutants themselves, such as those found in everyday items such as clothing. Are you concerned that nanotechnology you develop such as plastic or polymer particles could accumulate in the environment? And if so, what can be done to decrease this risk?

[lordofcatan10](#)

It is possible to have both. For sensors, the pollutant has a synergistic effect that causes a visible or detectable readout that is enhanced by a nanoparticle property, e.g. plasmonic or fluorescence. As a pollutant themselves, they need to be evaluated and screened. Gold is an example of an inert material that has the function for sensing although there may be concern on some catalytic behavior. One has to match it with the application, the concentration needed, and the safety environment or form of the material. Rigoberto Advincula

I am a early-career scientist in stimuli-responsive polymers. I see a lot of exciting work being done on targeted drug delivery systems. It's easy to feel that the area is saturated and/or mostly played out, particularly as more and more of the research makes it to the popular press. Do you get that sense? Why or why not?

Related: what do you think is the next "killer app" to come out of stimuli-responsive materials, that hasn't hit the popular press quite yet? Ie, if you were an early career scientist looking to make a name for yourself, what would you be looking into these days?

[cmcfaul](#)

It should still be a good field. The question of application is what interests you and also which industry can make the most of it. I believe it will be in coatings and perhaps pharmaceutical. Rigoberto Advincula

Can you explain the deep rooted conflict of interest behind academic funding in your discipline and corporate propaganda operations?

This is something that one of the reddit co-founders, Aaron Swartz, was studying intensely before he was taken from us by Carmen Ortiz and Stephen Hymenn.

[AssuredlyAThrowAway](#)

If you disclose or declare your source of funding, that is always an honest move. Then let others judge or correlate it. Rigoberto Advincula

Oi, very late to the game here. I do have an important question, however...

How do you feel about community colleges/universities offering Associates Degrees(2yrs) in "Nanofabrication Manufacturing Technology"?

Waste of money, or something that is actually ahead of the curve?

<http://catalog.northampton.edu/programs-and-majors/nanofabrication-manufacturing-technology.htm>

Thanks for your time!

[PresidentPen15](#)

Get a 4 year Bachelors's degree in a traditional science or engineering program if job is a concern. But not indictment on other programs. Just a matter of preference. Rigoberto Advincula.

At an ACS national meeting a few years ago, I remember POLY having a hospitality room or somesuch. I didn't visit it, but it sounded like an informal social gathering. I don't see anything like that on the schedule for the Boston meeting next week. Does POLY have any plans for a social gathering other than the POLY/PMSE post session? If so, is there any sort of secret handshake I can use to identify myself when I introduce myself to you?

[cmcfaul](#)

Yes, there will be and please visit the POLY booth and ask for the day and time. Please come. Rigoberto Advincula

Teach 7 & 8th grade students MESA...math engineering and science technology achievement. Took an ASM class this summer on materials. Any specific curriculum or handouts that you feel 7th and 8th graders would be able to utilize specifically to spark interest, steer them toward this field of study? Many thanks for the work you do.

[yengyangyong](#)

Usually at that age, best to let them see documentary and videos and bring them to museums. If possible encourage them to eventually do apprentice or internship in a University lab. Rigoberto Advincula

Drexler-style nanoassembly. Feasible? If so, when?

[FeepingCreature](#)

Perhaps, though I have not seen one that is proven and replicated. Rigoberto Advincula

Thank you for the AMA! This may be a general question but how will nanotechnology affect the field of Chemistry in academia in the near future? Are there any prospects of a breakthrough in nanotechnology that could affect the way we perceive modern Chemistry?

[ashouaib1](#)

See my previous answer:

https://www.reddit.com/r/science/comments/3gl26r/american_chemical_society_ama_hi_reddit_im/ctzbuhy

So somewhere beyond molecular chemistry - supramolecular or macromolecular chemistry. Rigoberto Advincula

Why does the American Chemical Society refuse to govern the chemicals that are put into

products? In the EU they have actual programs that companies must follow in order to use chemicals. The companies must prove chemicals are not harmful to consumers, whereas the Chemical society refuses such things... Why have you not banned BPA? Why did you fund the whole use flame retardants in beds in California?

[rickerwdi](#)

ACS is a professional organization and NGO. So most likely this guidance will come from the FDA. Rigoberto Advincula

what do you think about metal organic frameworks and other polymer frameworks?

[newgenome](#)

This is an exciting field, provided that it shows increased efficiencies in reactions and are cost effective - cost/performance ratio in actual applications. But the study of structure-composition-property relationships are exciting. Rigoberto Advincula

Cellulosic ethanol.

Are you optimistic, pessimistic, or ambivalent about advances in this area over the next few years? Why?

[bstamp1](#)

Hopefully it works. I am optimistic. But it may be a matter of the business model or economics of generating it. Rigoberto Advincula

What are the prospects in the US like for a chem eng graduate from a top UK university in terms of opportunities to not only become employed, but to innovate and push boundaries?

[alvihussain](#)

Network and take further graduate studies if necessary. Rigoberto Advincula

ACS Nano now has an higher impact factor than JACS. Why is nano so hot right now?

Also, the name of my next grant proposal is:

'Nano Femtosecond CRISPR for Green Cancer Bioinformatics'.

Think it'll get funded?

[MyPenisIsaWMD](#)

Not sure about the funding proposition - very challenging. But yes, ACS NANO is a dedicated journal with perhaps a wider interest. JACS is also a favorite journal but less audience, these days. Rigoberto Advincula

I studied nanotechnology for a year or two in college before deciding it wasn't for me. One of the issues we were talking about at the time was classifications for nano-toxology. I.e we have irritants (X) oxidising (O with flame) etc. Has there been any progress making identifications of what is and is not "toxic" when dealing with nanotechnology? And a nano-toxic symbol?

[Yuppie-puppy](#)

Not sure if there has been more standardization on labeling. But I can find out more myself. Rigoberto Advincula.