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FCHgo! INTERVIEW

Prof. Marcello Romagnoli - LIFC (UNIMORE)



Barbara Grazzini (InEuropa): We are live and ready to start.

Good morning everyone.

Good morning.

Today we have a new guest, professor Romagnoli. Thank you, Marcello Romagnoli, Coordinator of the multidisciplinary Lab on Fuel Cells of the University of Modena and Reggio Emilia.

Prof. Marcello Romagnoli (UNIMORE): Exactly.

Barbara Grazzini (InEuropa): Professor Romagnoli is a hydrogen and fuel cell expert and will tell and explain to us what fuel cells are. By the way, thank you Professor because you are the technician of our project FCHgo! and you are part of the team of the University of Modena, which is the Lead Partner of the FCHgo! project, and you'll lead us through the technical aspects of the project.

Prof. Marcello Romagnoli (UNIMORE): Well, I do much more. When I travel within Italy and around the world, I always talk about FCHgo! because it's a great project.

Barbara Grazzini (InEuropa): I'm very happy about that. Professor Romagnoli is helping us to build relationships with our stakeholders, such as companies, institutions, organizations and associations dealing with hydrogen as an alternative energy source. He also helps us in growing the relationships with such stakeholders, thank you also for that.

Prof. Marcello Romagnoli (UNIMORE): I don't want to brag, but I actually believe in this project because if this technology becomes popular, which is very likely to happen, it'll be essential that people know it and young people are interested in it and become sector technicians because companies will increasingly need them. It's vital that we have teachers educating the new technicians of tomorrow. It's important with projects like FCHgo! people are more aware about hydrogen and fuel cells. So, I wasn't bragging.

Barbara Grazzini (InEuropa): Absolutely. The important thing, the aim of the project is also introducing this subject to include it in the education curriculum. Thanks to scholars and technicians dealing with it, you can reach schools and communities to eliminate fear and misconceptions about hydrogen.

Prof. Marcello Romagnoli (UNIMORE): Exactly.

Barbara Grazzini (InEuropa): We have questions from some children we got in touch with concerning this subject. Some questions are basic but I believe they're essential to get into what we're talking about.

Prof. Marcello Romagnoli (UNIMORE): I'm ready.

Barbara Grazzini (InEuropa): I'll start with our first question. If fuel cells are the eco-friendliest option, why don't we use them to replace normal batteries?

Prof. Marcello Romagnoli (UNIMORE): It's not easy to answer this question, but it's a very good one because it has to do with our main themes. As in any other field, there are technologies which are good and efficient for some purposes, but less for others. It's as if in our kitchen we only had butter and spaghetti and we had to make butter spaghetti every day or we had a well-stocked kitchen with Bolognese sauce, pizza, meat, fish and so on. Which one would you choose? I reckon that 99,99% of you would like to have the second kitchen because having more possibilities means finding better solutions to different problems.

Fuel cells are suitable and excellent for some applications, but for other things batteries are better. There's more to it. In the case of batteries and fuel cells, despite some famous people opposing their combined use, it is not like that. They work perfectly together. For example, in fuel cell vehicles there isn't only a fuel cell converting hydrogen into electricity, because fuel-cell powered cars are electric cars, but also a battery pack, which are batteries serving two purposes. First, they give enough energy to start the car or pick up speed, like when, after waiting at a red light, the green light turns on and you need more energy to pick up speed. Fuel cells don't really like big energy changes, they prefer an energy need that remains constant, they're like marathon runners getting their pace and completing the 42 km of the marathon. They don't like to sprint, while batteries are much better at it.

Batteries can also do another thing. When you use the brakes, imagine that your car has energy inside. Movement is a form of energy, so where does the energy go when you brake? It generates heat in the brakes. If you ride your bike and use the brakes for too long, when you stop and touch the wheel, you can feel it's warm. Why? Because kinetic energy is converted from movement into heat. Engineers have therefore asked themselves why this energy has to become heat while it could be recovered. So, they have developed systems converting the kinetic energy into electric energy that they place inside the battery. It could also be placed in the fuel cell, but it's more complicated and less efficient. The battery is then used as a "buffer", as a tank where you can quickly store and take energy from.

The fuel cell provides the energy the battery cannot give. The two things work perfectly together and it's great that they work together.

Barbara Grazzini (InEuropa): Ok. I'll ask you something. I'm asking a question that is needed because we need to think that some people may be listening to us for the first time, so we must make sure they understand. What is a fuel cell? We take it for granted because we talk about it in our project, but if we explain it our audience will understand better.

Marcello Romagnoli (UNIMORE): If you want a complex definition, it is an electrochemical system converting the fuel chemical energy into electricity and heat. What does it mean? It simply means that it's an object taking the energy inside the hydrogen molecules, but you may also use other fuels like methanol, ethanol, ammonia, methanol. Inside these molecules, there is stored energy which we cannot use in that form. With this system we can convert the energy inside the molecules into electricity. There will always be some heat because nature has decided that its changes always imply some heat. But these are not strange things, we normally do them. When you turn on the cooker, for example, you do the very same thing in a different way because it generates 100% heat and no electricity. So, it's perfectly normal.

Fuel cells can do that, basically they are like a mobile phone battery. What happens? I charge it, then it runs out. Fuel cells are batteries running until I refill them with their fuel. But they're basically batteries, they're nothing strange. It's not even a new technology because it dates back to the 19th century, when it was first invented the type of fuel cell we use today.

It's always good to use old technologies which are eco-friendly.

Barbara Grazzini (InEuropa): Exactly. That's very important.

That's the goal of our project and what we do is also informing and educating people to make a positive impact on the environment. Go ahead, please.

Marcello Romagnoli (UNIMORE): Two things. The impact on the environment is very important, but we must pay attention to how hydrogen is made. Because if it's made from dirty sources, we're just playing a shell game.

Barbara Grazzini (InEuropa): What do you mean by “hydrogen made from dirty sources”?

Nowadays the most effective way to produce hydrogen, which is also the most used, is breaking down methane to get hydrogen and carbon dioxide. The carbon dioxide is then released in the air, so the environmental impact is not good. There are other methods, which need to be developed and become popular, to make eco-friendly hydrogen by obtaining only hydrogen. We need to follow this path. If we don't, there will always be a negative impact on the environment. That's one reason.

Then there's another reason which I'll try to explain in a simple way. There are people talking about climate change due to CO₂ and linked to CO₂ produced by human activities. There are people denying this and there is a debate among experts. Since it's not my field, I don't know who is right and wrong, but it is true that when a car passes by, you can smell the stink of harmful gases. The use of hydrogen therefore, no matter if climate change is our fault or not, is an asset, hydrogen produced in an eco-friendly way to have clean air. The other reason is that oil is causing conflicts and wars. If you make your own gas, which is hydrogen in this case, at home, you don't have to buy it elsewhere, money stays in your country and you can help many people by creating job opportunities for them and for young citizens. That's very important, too.

Barbara Grazzini (InEuropa): There's also another reason, correct me if I'm wrong. We'll run out of carbon fuels and we need to work on alternative fuels allowing the sustainability of our productive system.

Marcello Romagnoli (UNIMORE): People say that there is a peak oil, which means that after the highest amount of extraction of petroleum, there will be a gradual decrease of it and its price will be higher. Some experts say that we've already exceeded the limit, someone else says we haven't, but sooner or later we will get to the point where there will be so little of it that it will be very expensive.

That's why the sooner we find alternatives to oil, the better it is because it will be a gradual and less traumatic change. Since we are talking to children and students, it's like when you study for the oral test some days in advance, you study everyday little by little and you are much more prepared than if you studied just the previous night.

Barbara Grazzini (InEuropa): Can we say that water is an important source, can't we?

Marcello Romagnoli (UNIMORE): It's an important source but it's not the only one because actually if we consider the water molecule – remember that we are interested in hydrogen, that molecule has two atoms of hydrogen covalently attached to an atom of oxygen, while actually our body has plenty of hydrogen, also grass, even some kinds of clay, ground, have hydrogen in it.

So hydrogen is one of the most common elements on Earth, it's obvious that it's more convenient to obtain it from water than from the ground, but for example we are working to obtain it from the so called biomasses, that is organic waste i.e. cut from trees.

Barbara Grazzini (InEuropa): Pruning?

Marcello Romagnoli (UNIMORE): Pruning, exactly, we can obtain hydrogen from it... We've started to think about an amazing project, just to tell how we can obtain hydrogen from many things.

For example, we can obtain hydrogen from coffee grounds. Obviously, it is not a source of energy that can solve all the problems of the world. It's a small reserve of hydrogen that can transform a problem – waste – not only coffee ground produced at home, but also what is produced in bars and restaurants, into a resource.

In this case hydrogen can transform a problem into a resource.

Barbara Grazzini (InEuropa): Moreover, we can relate this to the concept of circular economy. We could talk about that for months, this is also a suggestion, through FCHgo we launched this international contest addressing schools and children to propose applications of the hydrogen technology, exactly to make space for ideas for that for example. A tip may be to further explore what laboratories like yours do, since you work every day to find out new sources of energy, this is certainly important. And it can be useful for high school students too... Sorry if I interrupt you, also to make them think about what to do in the future, which choice to make, why not, there are also these paths which, we remark, are the paths of the future.

Marcello Romagnoli (UNIMORE): Definitely. Guys, don't be afraid to share your ideas, even with people a bit more experienced than you, if you have an idea that doesn't work it's not a problem, it's better to explore your ideas, good or not they may be, rather than coming up with nothing. So, don't be afraid to think about new things and express and compare them. Sometimes comparison can improve ideas, the worst thing would be not to have ideas.

Barbara Grazzini (InEuropa): That's true, guys don't be afraid to ask questions because we are dealing with new issues and one can feel not so prepared about them and be afraid, you must go for it and ask questions to know more and to be aware of the choices you make. Let's get back to the questions, earlier you made the example of the car battery. You said that a car using a fuel cell system is an electric car.

Marcello Romagnoli (UNIMORE): Yes, definitely.

Barbara Grazzini (InEuropa): One of the questions was: "When I'll grow up, do I have to choose a hydrogen car or an electric car to make a sustainable choice?"

Marcello Romagnoli (UNIMORE): The right answer is: I don't know, and nobody knows. It is very difficult to imagine and think about the future in 10, 15, 20 years time. It is difficult because technology evolves very quickly. I can answer according to current technology: today, If I have to drive relatively short distances, for example if I drive 100, 200 km a day, I go to work, buy groceries, go to the gym in the night or see my friends and come back home, I mean if I just drive those kilometres and I don't get to drive more, then I can say that a battery-powered electric car does its job very well.

If I had to drive more, there are people that drive yearly 100,000 km, or if I were a truck driver, someone that has to carry freight, so I have a very heavy truck, in this case a fuel cell system combined to a battery is the best and most successful option. Then who knows, maybe in 10, 20 years time things will have changed but I don't think anyone is able to say for sure how it will be the situation in 20 years.

Barbara Grazzini (InEuropa): The only thing we can say in this case is that we promote knowledge, study and applications to understand where we are headed. Someone asked: "If I wanted to do an experiment, if I wanted to create a fuel cell at home, would I be able to do it?"

Marcello Romagnoli (UNIMORE): That's a bit difficult because you need some materials you can't easily find in a grocery store because you need a very specific kind of plastic, a bit of platinum and so on, it's much easier to obtain hydrogen, meaning: the opposite of creating a fuel cell.

Obtaining hydrogen is a much simpler operation you can do also at home, obviously you must pay attention, and be followed by your parents or teachers because you have to follow some procedures that, although are not that dangerous, but require attention. Talking about danger, I need to be careful also when I cut a steak with a knife. Also when I drink I must pay attention because, if I drink water too much quickly it can go sideways.

Barbara Grazzini (InEuropa): Yes, you can choke.

Marcello Romagnoli (UNIMORE): Let's say there are some things you can do without any problems. Making a fuel cell at home is a bit more complicated, that's not impossible, it's just more complicated.

Barbara Grazzini (InEuropa): Maybe we can make another dedicated video where they can see how to make the experiment, this can be interesting. Marcello, do you want to show the video now or at the end of the interview?

Marcello Romagnoli (UNIMORE): At the end?

Barbara Grazzini (InEuropa): As you prefer.

Marcello Romagnoli (UNIMORE): At the end it's ok. Basically in this video I show a little laboratory system, it's a system I use in teaching, so it's very easy, we also have much more complex instruments but they were too difficult to understand in a video so I chose an instrument that does its job very well but it's much easier.

A cell is connected to a hydrolyzer, which is a producer of hydrogen. It takes water and breaks it down into hydrogen and oxygen using electricity, then hydrogen gets into the cell and the cell transforms it into electricity and water. There is a system that is able to quantify how much electricity it produces and how many watts.

This object is connected to a computer that records everything. In this case we could use it because we are working with colleagues, that's the importance of working in a group where each one has its own competences, so we don't fight about who is the best but everyone shares their experience and ability that others might not have and this brings value to our work.

What do these colleagues do? They are modelling experts, they are able to create mathematical models which transfer information related to a real cell to a virtual cell in a computer. This is very important because it enables us to see what we can't see in real life or it allows us to do quick experiments that we study in the laboratory and such data are useful to adjust their model.

Barbara Grazzini (InEuropa): That is interesting and amazing, so we'll let you see the video in a while. In the meantime I thank a lot prof. Romagnoli, our expert, we call these interviews "meet an expert" because we go deeper and try to understand topics. We also collect questions that can come to mind to children and teachers too, we will answer all of them.

Marcello Romagnoli (UNIMORE): I can give you my e-mail address.

Barbara Grazzini (InEuropa): Yes!

Marcello Romagnoli (UNIMORE): If pupils or teachers want to write to me, I'm available. Maybe I won't reply straight away, so, if it is necessary you can send me a second email because I receive so many of them and I don't always read them all, so feel free to send me more emails. If I don't reply don't take me for rude but it's because we are always full of work, but if you have some ideas or if you want a suggestion, I'm very glad to help.

Barbara Grazzini (InEuropa): Danica, our "film" director, please show the e-mail address now or during the video of the experiment. There it is, the e-mail address is visible, thanks for this opportunity because this greatly helps us to encourage schools to participate. If you have further doubts about your ideas I'm glad the professor is available to give suggestions or explanations, that's extra help.

Now we found out videoconferences are an opportunity to send positive messages and solid information to our users.



Marcello Romagnoli (UNIMORE): That's perfect.

Barbara Grazzini (InEuropa): We thank you again, that's the end of this short interview but we will certainly call you back because maybe there will be other questions that need answers. Thank you again, have a nice day, thank you all. We leave you now to the video of the experiment done by the Multidisciplinary Lab on Fuel Cells of the University of Modena and Reggio Emilia. Thank you professor Romagnoli.

Thank you, bye everyone.

Bye.

VIDEO BY UNIMORE, prof. Romagnoli:

Well, let's see a practical system we've realized in the laboratory.

Let's start with the electrolyzer. We need hydrogen and this system allows us to obtain pure hydrogen that will be sent to the cell generating electricity.

Here we can see an electric transparent cell, a laboratory cell. So, it is not exactly a cell you can find in a real system but it's useful because it allows us to see what happens.

This cell is connected through the red pipe to the electrolyzer, so the hydrogen will come from its left side, inside of it there's the electrolytic cell that produces electricity while this blue bigger pipe is for the air.

The system to which it is connected is a pump that enables to send the right amount, a controlled amount of air to the cathode.

Then there are two big cables. These two big electric cables are plugged into the control and detection system of the cell activity. This system, this cube with this flashing light is in turn connected to the software running on a laptop. This is the software running the system. You can see both numerical data— now it's measuring – and graphics showing its voltage and power.