

## Interview with Dheeraj Varanasi

Dheeraj started his PhD studies at the University of Miskolc in 2016 and obtained his doctoral degree in 2020. His success story can inspire anyone to study abroad and we can also get an inspection on materials sciences.

### **Why did you choose to come and study in Hungary? What attracted you to the University of Miskolc?**

When I was looking for a PhD course, I was looking at scholarships. I saw the Stipendium scholarship in Hungary. I knew about Hungary and Budapest from my history in school. I was excited at the prospect of coming and living in Hungary. I approached my supervisor Dr. Baumli Peter 6 months before to interact, build a rapport and to talk about the research field and direction. He helped a lot and encouraged me throughout those 6 months and then four years in my PhD. I guess I felt at home in the initial days because of the warmth I got from the faculty. University of Miskolc is the best university in the country for Materials Science and boasts esteemed and established names in the academia.



**How did Materials Science become a part of your life?**

My interest in Materials Science was invoked by my professor who taught us the subject during my M.Tech (Masters in India). I was introduced to the world of possibilities in materials.

**What has been the biggest challenge during your studies?**

PhD is all about patience and I guess I was very worried during the first two years of my studies when the experiments were not yielding the desired results. I think being patient with the process and trusting in what I am doing was right has to be the most difficult part of my PhD. There were times where I questioned if I will ever finish it, but in the end it all worked out well.

**What are your research fields? What should a layperson know about these fields? What makes them important and interesting for us?**

I mainly studied the steel/tin and steel/copper interactions with focus on metal joining applications like soldering and brazing. These applications are at the heart of electronic, refrigeration and space industries where most components today are either brazed (copper) or soldered (tin) and thus are important to us. As a sub-field I studied the concepts of wetting and grain boundary penetration phenomena. Wetting is actually important in our every day life and we see it everywhere. The layman example of application of wetting would be the non-stick pans we get for cooking. The material they coat on those pans have property of anti-wetting (hence the term non-stick) where any liquid (in this case batter/dough) does not stick on to the surface of the pan. These are made by studying the concepts of wetting phenomena.

**What are the most and the least interesting parts of your work?**

Most interesting part personally for me is when I get to do experiments. I love the whole process of cleaning the substrates, using the furnace, doing the experiment and getting the desired result when analyzed. Least interesting part is definitely writing up reports and documenting every single thing we did during the experimentation. It is definitely tedious and boring but also is very important for retrospection and for future works.

**Are the laboratories of the University of Miskolc well-equipped enough for such researches? What kind of equipment do you use?**

Yes, the faculty of Materials Science is equipped with all the equipment required for my line of study. I mostly used vacuum furnace for my experiments, metallographic equipment (ultra-sonic cleaner, grinder and disc polisher) for cleaning of my substrates and Scanning Electron Microscopy, X-ray Diffraction etc for the result analysis.

### **How do you process the collected data? What kind of methods are used? How do you develop new methods?**

Data processing is mostly done using MS Excel. I do not use very complicated softwares because mostly my work is experimental. I use Excel for analyzing the data and look for patterns, trends and any other similarities I could draw up graphs and compare the results of same parameter in two different materials or vice-versa. To predict the steel/tin or steel/copper interactions before hand I used PANDAT and FactSage thermo-calc softwares where the various phase diagrams between materials can be plotted depending on the input temperature, concentration and pressure.

### **How could your researches and measurements help our society and our world?**

The two most important findings in my research are...:

**A.** The temperatures at which the natural oxide layer on the surface of steels is disintegrated under vacuum heating. This is really important for metal joining industries as these temperatures are needed to maintain for obtaining a good interaction between the solid steel and liquid braze (copper) and hence a good joint is obtained.

**B.** Second finding is that how the brazed joint is effected by the addition of manganese, sulfur and chromium in the steel. These elements have a detrimental effect in combination with sulfur because they form sulfides in the brazed joint which leads to the failure of the joint in the long run. In conclusion a graph was drawn between the solubility product of (manganese\*sulfur) in steel and time taken to observe the crack in the brazed joint - "braze integrity diagram". This is a very significant result for the brazing industries.

My study was focused on improving the qualitative aspects of brazed joints and steel/copper and steel/tin interactions. These were published in prestigious international journals (A. Archives of Metallurgy and Materials, B. Journal of Material Engineering Performance).

### **What is your favourite memory of your Hungarian stay so far?**

There are quite a few memories made in the last four years and I cannot pinpoint on one as such. I loved the whole journey, every step of it (in retrospection). Probably I would have to say my very first year was the most memorable of all. Could be because of variety of reasons like getting used to a new culture, new way of life, mingling with literally people from around the globe. I sure did have a lot of fun in my first year.

### **Would you recommend the University of Miskolc for other people and why?**

Yes, I would recommend University of Miskolc for anyone out there looking for a cleaner campus, affordable in-campus housing and excellent faculty. You would sure have lot of fun, just take that first step into the open.

### **What are your plans for the future? Where do you think you will be in 20 years' time?**

I would want to work in a laboratory and be in the research field as of now. I love the grind in the work. My one goal is to go back to India maybe after 10 years and opening up a consultancy/research laboratory. I

want to encourage the next generation of Indians to take up science and research as viable options for career. My understanding is that the research output is low in India but we have a lot of potential. I would want to tap into that potential and encourage the bachelor (B.Sc.) students to take up research and improve the research output of my country.

**The staff of the University of Miskolc wishes Dheeraj a very fruitful and productive career!**

Miskolc, 27th April 2021.