3D Printing in Nickel Superalloys by Selective Laser Melting

Speaker

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Transcript

My name's Luke Carter, I'm a PhD student here. I'm researching the effects of selective laser melting fabrication on nickel superalloys for use in high temperature aerospace components effectively.

Well the piece we're making today is just a demonstration piece, a small keyring with the university logo on and one of the reasons for doing that is because most of our work is very heavily tied with industry and we can't show a lot of the components that we make. But effectively it was a CAD model that I drew up and we take that model and virtually slice it into a whole sequence of two dimensional shapes, then the laser selectively melts each one of those slices in turn and bonds it to the previous layer. After one layer has been selectively melted the next layer of powder is spread across by a recoater blade, including a small drop in the build platform, and this happens over and over again, so your final part is effectively buried in the metal powder and we have to dig it out at the end of the day.

Traditionally with machining you might think about starting with a large lump of material and then cutting it away until you have the shape that you want, whereas with additive manufacturing methods you start with, in this case, a metal powder and then you build up the three dimensional shape directly as you want it so it's a net shaping process, you're producing the overall net shape directly from the cad file, from the computer file. The technique might be useful for production, especially when thinking about low batch numbers, so traditional methods, say investment casting, can be quite cost effective if you're making hundreds of thousands of things every year but if you start to make maybe only a couple of hundred a year you might want to think about going to this method which doesn't require those expensive set-up costs or custom made tooling for each piece. Each piece could be individual or bespoke, depending on the application.

In terms of what we do here, which may be a little bit different to rapid prototyping which is sort of fairly well known and generally produces pieces in plastics, we're producing metal components here and the aim is for those to be fully dense and functional components. So rather than thinking about this being a rapid prototyping technique, it's more of a rapid manufacturing technique.

Our current projects involve nickel superalloys, so for aerospace engines typically, titanium alloys and aluminium alloys but there are plans to have more exotic materials in there. Here in the School of Metallurgy and Materials, we're trying to focus on the effect of the selective laser melting process on the material itself, with the aim being to produce a component at the end which has the same mechanical properties as a conventionally cast material or a machined material, but obviously it's being formed in a very different way so we need to look at each material in detail and look at exactly how the laser process is affecting the micro structure, which ultimately affects the material's properties.

And here's the finished product. The next step would be to EDM wire cut this from the base plate and it might go on for further heat treatment or finishing if it was a functioning component.

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