Breakthrough in Bulk Characterization: New Insight Into Aluminium

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Aluminium is a metal widely used in industry; therefore the more that is known about it, the more effectively it can be used. Researchers at Riso National Laboratory in Denmark and the European Synchrotron Radiation Facility (ESRF) in France have **filmed in 3D the changes in the bulk of deformed aluminium after annealing**. Thanks to the uniqueness of the synchrotron light at the ESRF, this kind of experiment could take place for the first time ever. The results give a new insight into this metal and contradict classical assumptions. They are published today in the journal Science.

Take a can. The aluminium that you see has been processed before having the shape of a cylinder. In a first stage, the aluminium is deformed. The energy is concentrated in its bulk. Then it goes through a process of annealing to get the shape of the can. In the annealing process, grains grow in the bulk. Up to now, there was a general assumption that the grains grow smoothly and in a regular shape. With the power of the X-rays at the ESRF, researchers have proved that the grains grow very irregularly. These changes of aluminium are of great importance for manufacturers in order to know how to process it to get certain properties, such as more strength.

The experiment is a real breakthrough in the field, since the previous studies on metals were in 2D and focused on the surface. The team has achieved measurements that go into the bulk, which has a very different structure than the surface. They followed the grain as it grew after annealing the metal. “Individual grains don’t behave like average and

having a look at the local scale will help to create a better model", explains Lawrence Margulies, one of the authors of the paper.

The in situ measurements were done using the 3D X-ray diffraction microscope at the ESRF. The sample had a pre-annealing period of one hour at 260°C. Afterwards, it was put in a furnace that rose the temperature from 270° C to 290°C. Researchers took 73 snapshots of the grain during almost 30 hours and made a movie where one can clearly see the irregular growth of the grain in a micrometre spatial resolution.

The technique developed at the ESRF is non-destructive and can also be used to determine the microstructures of other metals, ceramics or polymers in a spatial resolution of micrometres and a time resolution of minutes.

Source: ESRF