Helium Ion Microscope (HIM) assisted atomic re-design makes brittle aluminium oxide plastic

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The Helium Ion Microscope is a fascinating young technology. Its unique capabilities, including sub 10nm structuring, imaging non-conductive samples and its ability structure semiconductors while avoiding the gallium poisoning make it a versatile tool in materials research and design.

This study shows how the Helium Ion Microscope (HIM) can help rearrange a nanoporous anodized alumina material on the atomic scale and to shrink its pores well below the sizes it is possible to produce by common electrochemical anodization method. The Helium Ion Microscope, in which a beam of energetic helium ions is scanned across a sample, allows one to play with atomic rearrangements, diffusion and propagation of defects and can therefore be used to manipulate nanoscale and mesoscopic structure of materials with unprecedented precision while being able to see the induced changes in real time. The originally brittle and porous ceramic turned superplastic and gained the ability to stretch more than twice without breaking.

This presentation focuses on the underlying ion solid interactions with the aluminium oxide sample and aims to explain why the material re-design occurs when irradiating the sample with helium ions.

The findings, presented here, offer a unique opportunity to transform energy with nanometre precision in a fast and effective way into the sample with very little material removal in the process. The process can easily be scaled up which is important for industrial applications. The basic technology already exists in industry. This means that large areas of the porous aluminium oxide can be modified with nanometre precision. The Helium Ion Microscope can do more than imaging and nanostructuring samples. It can also atomically re-design materials which display vastly different behaviour than their original phase. You are only limited by your imagination in materials design."

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