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Repot: Strain-Induced Ultrahard and Ultrastable Nanolaminated Structure in Nickel

Understanding:

The main idea of this journal I understood. How they were altering the structure of Nickel to produce an outer shell that is stable at room temp and is harder than the normal structure of Nickel with a nano-thick lamination. I knew the principles of how to strengthen most metals, with introducing more grain boundaries or generating more dislocations. This was brought up in class a lot. The paper also talked about closely packed planes with the coordinate numbers which I remembered from earlier this year and could visually see it when they talked about it with the figure showing the image that went with it so I could see the real world look of the grains on the planes. They made sure there were no contaminations in the layers under 5 micro-meters from the limit of the electron probe micro analyzer. I would see how this would be helpful for preventing any unknown factors that would cause for inaccurate readings. They were testing different shear deformations, rates, and strain gradients to the top surface layer of the sample to determine the effects created. Large strain gradients is higher dislocation density to stain gradient, low angle boundaries in nanoscale is more favorable with increased density of stored dislocations with minimum excess energy use. The use of the ultra-hard and ultra-stable for the top layer is to help the wear resistance and fatigue of the product or sample. It can also be used for diffusion of kinetic and chemical reactivity when it has very high energy stored in it. They mension that this process is simple and is cost-effective in the process the metal undergoes for the nanostructure. This can be used for applications in a wide range of industrial manufacturing. I wouldn't know how stable it is without a real-world presentation but the results seem promising though most of the numbers are arbitrary to a degree for me. I would have to develop a little more background to understand in a greater extent of the results by just looking at the numbers presented.

What I didn't know:

I didn't know that heavy plastic deformation could refine grains of metals to make them very strong. I was thinking only that grain altering would allow for strengthening, like with cold work. I also learned that increasing strain can create coarser grain at ambient temperatures by reducing the grain size increasing grain boundaries and dislocations removed; which I presume is the counter act of cold work. The processes are also new to me I learned about the surface mechanical grinding treatment which can be done at ambient temperatures, which they used on the surface of the test sample causing plastic shear in a gradient. They used very high shear deformation and with a strain gradient to the surface layer of a pure nickel sample. The article noted that dislocations are mainly at low angle boundaries in deformed metals and the volume between them are even lower in magnitude allowing for them to be neglected. When in lecture I was thinking that the dislocations are sporadic with no meaning for the location. The journal also mansions how they measured the large fraction of high angle grain boundaries of the ultra-fine grain by using electron back-scattering diffraction and convergent beam electron diffraction. It wasn't really defined what these different measurements did but I assume they allowed for a more accurate measurement of the 3D grains they were looking at. I was really lost when they talked about the elongated diffraction spots in the selected areas electron diffraction pattern, but it was used for observations to identify the structure characteristics of the boundaries between the lamellae also unknown to what this is. I learned what the typical textures for pure shear in FCC metals where in figure two. I understood the dislocation density formula to some degree but do not understand how they derived it. It also was mentioned that they measured boundary spacing to determine the thermal stabilities.