Novel and Unknown Applications of Texture Research

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Abstract

We would like to present our texture research in the area of nuclear materials. The development of Generation IV and Small Modular Reactors (SMR) illustrates how texture might be considered for a better understanding of thermal and mechanical properties to make the reactor operation safer.
1. We will discuss the thermodynamic prediction of hydride distribution on Zr alloys that illustrates the relation between hydride orientation, the stress and crystallographic orientation of hydride platelets in textured Zr alloys.

2. Another type of texture role is to control the oxidation of different Zr-textured alloys to evaluate the rate of hydrogen ingress that is texture-dependent.

3. Traditional Urania nuclear fuels are exposed to irradiation damage in the reactor, and new composite fuels to improve the thermal conductivity are designed. We demonstrated that textures and interfaces respond differently to irradiation damage and this affects the thermomechanical characteristics of fuels.

4. Urania fuels are isotropic, however our analysis shows that the geometry of arrangement of the fuel, temperature gradients and the magnetism of fuel make it anisotropic. As a result, the texture becomes of importance for controlling thermomechanical properties.

5. New high thermal conductivity nuclear fuels are being developed and since the fuel has metallic characteristics, the oxidation of such fuels has to be understood. The Density Functional Theory (DFT) is used in our research to understand how different planes of U silicates are oxidized and what oxides are formed on different crystallographic planes.

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