Phase-field Method in Analysis of Nanocomposite Morphological Stability

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Abstract

Cu-Nb multilayer nanocomposite has prospective applications in nuclear industry because of its ability to self-heal from radiation damage. The goal of the study is to find a suitable joining method for the composite to produce industrial-scale pieces, free of defects threatening the stability of the microstructure. This work is focused on studying the morphological stability of the nanocomposite structure during different joining processes aimed at producing industrial-size pieces of material. The evolution of the microstructure is predicted using multiple-phase-field model, decomposed into a system of coupled PDEs in COMSOL Multiphysics®. The 2D simulations of diffusion joining process based on the experimental trials (Figure 1) don't show crucial microstructure instabilities so far. The model is developed further to find out whether defects appearing when using other methods (e.g. laser welding) are crucial for the microstructure.

Reference

1. Provatas, Nikolas and Elder, Ken, "Phase-Field Methods in Materials Science and Engineering", Wiley-VCH, Weinheim, Germany, 2010
2. Chen, Long-Qing et al., "Continuum Scale Simulation of Engineering Materials: Fundamentals - Microstructures - Pricess Applications", Wiley-VCH, Weinheim, Germany, 2004

Figures used in the abstract

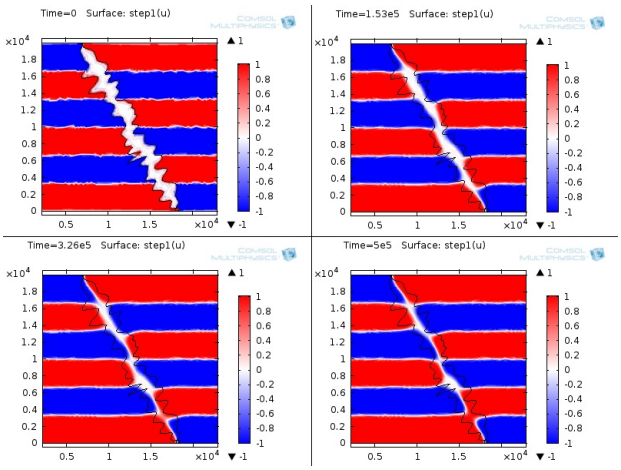

Figure 1: Simulation of diffusion joining of two samples of 330 nm layer thickness with rough surface and misaligned layers.