**NEW METHODOLOGIES FOR MATHEMATICAL REPRESENTATION AND COMPUTER SIMULATIONS OF MICROSTRUCTURAL GEOMETRY: APPLICATIONS TO LIGHT ALLOYS AND THEIR COMPOSITES**

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**ABSTRACT**
High-resolution large-volume segments of three-dimensional microstructures of a set of boron modified Ti-alloys containing TiB whiskers have been reconstructed and visualized using montage serial sectioning. These microstructures have been quantitatively characterized in detail using stereology and digital image analysis. A novel methodology has been developed for computer simulations of realistic two-dimensional (2D) and three-dimensional (3D) two-phase microstructures where the features have realistic complex shapes/morphologies, spatial clustering, morphological anisotropy, and global microstructural properties statistically similar to those in the corresponding real microstructures. The methodology was applied for simulations of realistic 2D and 3D microstructures of a set of discontinuously reinforced Al-alloy (DRA) composites containing SiC particles of complex shapes and different degrees of spatial clustering, and microstructures of a set of boron modified Ti-alloys having different degrees of morphological anisotropy of the TiB whiskers. Large windows of real and simulated 2D and 3D microstructures have been implemented as representative volume elements in the finite elements based frameworks to simulate the mechanical response.

**SUBJECT TERMS**
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