Grain Growth and the Puzzle of its Stagnation in Thin Films: A Detailed Comparison of Experiments and Simulations

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Abstract: We revisit grain growth and the puzzle of its stagnation in thin metallic films. We bring together a large body of experimental data that includes the size of more than 30,000 grains obtained from 23 thin film samples of Al and Cu with thicknesses in the range of 25 to 158 nm. In addition to grain size, a broad range of other metrics such as the number of sides and the average side class of nearest neighbors is used to compare the experimental results with the results of two dimensional simulations of grain growth with isotropic boundary energy. In order to identify the underlying cause of the differences between these simulations and experiments, five factors are examined. These are (i) surface energy and elastic strain energy reduction, (ii) anisotropy of grain boundary energy, and retarding and pinning forces such as (iii) solute drag, (iv) grain boundary grooving and (v) triple junction drag. No single factor provides an explanation for the observed experimental behavior.