The grain boundary character distribution (GBCD) is the relative areas of grain boundaries, distinguished by their lattice misorientation and grain boundary plane orientation. It is hypothesized that for a given polycrystalline material, grain boundary energy anisotropy and geometric constraints lead to a deterministic, anisotropic GBCD. After a transitory initial state, the GBCD will be a scale-invariant characteristic of the microstructure during grain growth. Manipulation of grain boundary energy anisotropy or geometric constraints should allow for predictable manipulation of the GBCD and perhaps GBCD-dependent properties. To test the hypothesis of scale-invariant behavior of the GBCD with grain growth, we have used orientation mapping in the SEM coupled with a stereological analysis to measure the GBCD in polycrystalline strontium titanate at several time steps during grain growth at constant temperature. Quantitative comparisons of the distributions show self-similar behavior of the misorientation-averaged grain boundary plane distribution with grain growth while the five parameter GBCD evolves in such a way that the higher energy boundaries are preferentially eliminated. A comparative study of the GBCD in commercially available “reference” and “grain boundary-engineered” Ni will also be discussed, as an example of a case where the stored strain energy drives the changes in the microstructure.

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