ON THE CONDITIONS FOR SUPERPLASTICITY IN NANOCERAMICS

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Superplasticity is the result of the ability of some materials to accommodate grain boundary motion with no elastic energy storage during plastic flow; i.e. no microstructural evolution proceeds. It is widely-accepted that grain boundary nature is the keystone for the comprehension of plastic flow in polycrystalline materials. Superplasticity in ceramics is a reported fact after Wakai and coworker's discovery in 1986. Since then, an extensive effort has been carried out to fully understand the kinetics of grain boundary sliding and the accommodation processes. The main goal is to extend this phenomenon to the potentially attractive region of low temperatures or high strain rates. In this context, the availability of nanoceramics; i.e. polycrystalline ceramic specimens with grain sizes well below 100 nm, has opened promising perspectives. In the extreme conditions of very small grain sizes, the grain boundary mobility is found to depend in a crucial way on the chemical nature of the grain boundaries and also on the grain boundary diffusion of the chemical species controlling mobility. A very careful analysis ought to be made in any particular ceramic system, since minor chemical effects at the microscale can give rise to unexpected plastic response at the nanoscale, either enhancing superplasticity or inhibiting it.

This talk will put insight into the elementary mechanisms accounting for superplasticity in nanoceramics. The recent discoveries made by the authors on some ceramic systems with reinforced superplastic reponse will be emphasized. The nature of the grain boundaries and its role in superplasticity will be discussed.