Void size effects in the plasticity of porous single crystals

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Initiation and growth of sub-grain voids is a known mechanism of failure in crystalline materials. At micron length scales and below, plasticity size effects can be important in determining the yield stress and void growth rates in a material. In this study, we use two dimensional discrete dislocation plasticity (DDP) to investigate the void size dependence of yielding and void growth in a porous single crystal. Plastic deformation of periodic unit cells of a porous crystal under strain and stress controlled loading will be simulated using DDP. Further, a continuum plasticity model for a porous single crystal is derived using homogenization and limit analysis theory, and validated by comparison with crystal plasticity and discrete dislocation dynamics simulations. Extensions of the continuum model to account for the physical length scales that control size dependent behavior are discussed.