

SELFCONSISTENT DETERMINATION OF THE X-RAY ELASTIC CONSTANTS OF POLYCRYSTALLINE MATERIALS FOR ARBITRARY CRYSTAL SYMMETRY

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For the calculation of load or residual stresses from measured strain data by means of x-rays or neutrons, the x-ray elastic constants are required. Usually they are calculated from the corresponding single crystal data assuming some models such as Voigt, Reuss, Hill or Kröner. In this paper, the finite element method is used to guarantee both, stress equilibrium and strain compatibility across the grain boundaries. The polycrystalline material is assumed to behave as a three-dimensional mixture of macroscopic isotropic and fully orthotropic grains under elastic loading where the relative ratio of both types of grains can be chosen. The method is applicable to materials with a random texture by calculating the hkl dependent quasiisotropic x-ray elastic constants as well as to specimens with a given texture using the information of the Orientation Distribution Function (ODF) by calculating the corresponding hkl- and orientation dependent stress factors. All crystal structures are supported. The method is demonstrated on trigonal Al_2O_3 and monoclinic SiO_2 . A WINDOWS based software has been developed.