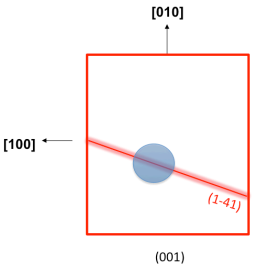
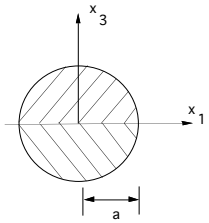
TAM 524 Name_____

Homework#2 Due February 13, 2017

1. Consider the twin embryo formation in an austenitic matrix (B2). The elastic constants are given in lecture notes (C_{11}=137,C_{12}=120,C_{44}=34GPa). It is uniform within the twin and is active on the system $(1\bar{4}1)[212]$. Use Eshelby's equivalent inclusion principle. Set up the equivalence but do not solve the equation. Note the twin is oriented with respect to the matrix, hence has different elastic constants. Determine the elasticity matrix in twin coordinate frame (ps. Ezaz, T., H. Sehitoglu, H.J. Maier, Energetics of (114) Twinning in B2 NiTi under Coupled Shear and Shuffle, Acta Materialia, 60, 1, 339-348, 2012).



2. Consider the martensite inclusion (in spherical shape) shown below. Assume isotropy. The eigenstrain is idealized as



$$\varepsilon^*_{31}(x) = \pm\frac{1}{2}g \qquad x_3 \gtrless 0 \text{ in } \Omega$$

where g is a constant determined from crystallography and a is the radius of the martensite particle.The martensitic particle is sheared in such a way that the sense of shear changes when the boundary x_3=0 is crossed. Determine the internal stresses and strains and plot the results as $s_{31}/E.\varepsilon^*_{31}$ versus x_1/a . Are the stresses uniform in the inclusion? Are there normal stresses developed within the martensite ?

3. The lattice mismatch of cuboidal precipitates with the matrix results in an eigenstrain of the form $\varepsilon^*\delta_{ij}$. The cuboidal precipitate has dimensions 2a (all sides are equal). You can solve : (1) Using the Green's functions (Equations 6.1 Mura) for full space, or (2) use Equations 11.33 and 11.34 and compute the D_{ijkl} tensor for the cube case. Numerical integration needs to be considered. Plot the strain distribution $\varepsilon_{22}/\varepsilon^*$ on the x1 - x2 plane. Then, plot the normalized stresses in x1 and x2 directions. Assume isotropy (poisson's ratio of 0.3) and same moduli for matrix and precipitate. Are the shear stresses and strains zero? Is the $\sigma_{11}/E\varepsilon^*$ continuous across the interface?