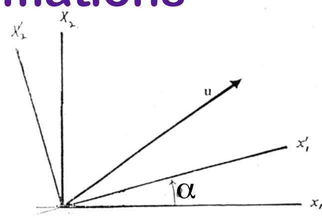
Coordinate Transformations

- **Just as with stress, we can transform the 2D strain components in one coordinate system into another oriented at some angle, α, from it.**



$$\frac{\Delta l}{l} = \varepsilon_{1'1'} = \varepsilon_{11}\cos^2\alpha + 2\varepsilon_{12}\sin\alpha\cos\alpha + \varepsilon_{22}\sin^2\alpha$$

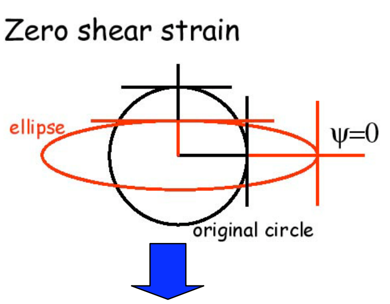
$$\varepsilon_{2'2'} = \varepsilon_{11}\sin^2\alpha - 2\varepsilon_{12}\sin\alpha\cos\alpha + \varepsilon_{22}\cos^2\alpha$$

$$\varepsilon_{1'2'} = (\varepsilon_{22} - \varepsilon_{11})\sin\alpha\cos\alpha + \varepsilon_{12}(\cos^2\alpha - \sin^2\alpha) =$$

$$\frac{1}{2}(\varepsilon_{22} - \varepsilon_{11})\sin 2\alpha + \varepsilon_{12}\cos 2\alpha$$

Strains in Principal Strain Frame

- **For a line segment of arbitrary orientation in the undeformed state, given by the angle α with respect to the principal coordinate axis X_1 the extension and shear strain for infinitesimal plane strain are**



$$\varepsilon_n = \varepsilon_1\cos^2\alpha + \varepsilon_2\sin^2\alpha$$

$$\varepsilon_s = (\varepsilon_2 - \varepsilon_1)\sin\alpha\cos\alpha$$