

MPG No. 10.1.32 $\bar{4}$ [Type I, tetragonal] [G tensor]

* Rank 0 tensor. * Rank 1 tensor.

$$[0 \ 0 \ G_z]$$

$$G_z = G_{pz}^{(1)}$$

* Rank 2 tensor (s).

$$\begin{bmatrix} G_{xx} & G_{xy} & 0 \\ G_{xy} & -G_{xx} & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$G_{xx} = G_{dv}^{(1)}$$

$$G_{xy} = G_{dxy}^{(1)}$$

* Rank 2 tensor (a). * Rank 3 tensor (s).

$$\begin{bmatrix} 0 & 0 & G_{xxz} \\ 0 & 0 & G_{xxz} \\ 0 & 0 & G_{zzz} \\ G_{yzx} & G_{yzy} & 0 \\ G_{yzy} & -G_{yzx} & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$G_{xxz} = -G_{faz}^{(1)} + G_{pz}^{(1)}$$

$$G_{zzz} = 2G_{faz}^{(1)} + G_{pz}^{(1)} + 2G_{pz}^{(2)}$$

$$G_{yzx} = -3Q_{du}^{(1)}$$

$$G_{yzy} = -G_{faz}^{(1)} + G_{pz}^{(2)}$$

* Rank 3 tensor (a).

$$\begin{bmatrix} G_{yzx} & G_{yzy} & 0 \\ -G_{yzy} & G_{yzx} & 0 \\ 0 & 0 & G_{xyz} \end{bmatrix}$$

$$G_{yzx} = -Q_{du}^{(2)} + Q_s^{(1)}$$

$$G_{yzy} = G_{pz}^{(3)}$$

$$G_{xyz} = 2Q_{du}^{(2)} + Q_s^{(1)}$$

* Rank 4 tensor (sss).

$$\begin{bmatrix} G_{xxxx} & 0 & G_{xxzz} & 0 & 0 & G_{xxxx} \\ 0 & -G_{xxxx} & -G_{xxzz} & 0 & 0 & G_{xxxx} \\ G_{xxzz} & -G_{xxzz} & 0 & 0 & 0 & G_{zzxy} \\ 0 & 0 & 0 & G_{yzyz} & G_{yzzx} & 0 \\ 0 & 0 & 0 & G_{yzzx} & -G_{yzyz} & 0 \\ G_{xxxx} & G_{xxxy} & G_{zzxy} & 0 & 0 & 0 \end{bmatrix}$$

$$G_{xxxx} = 2G_{dv}^{(1)} + 4G_{dv}^{(2)} + G_{gv}^{(1)}$$

$$G_{xxzz} = G_{dv}^{(1)} - G_{gv}^{(1)}$$

$$G_{xxxy} = G_{dxy}^{(1)} + 2G_{dxy}^{(2)} - G_{gbz}^{(1)}$$

$$G_{zzxy} = G_{dxy}^{(1)} + 2G_{gbz}^{(1)}$$

$$G_{yzyz} = -G_{dv}^{(2)} + G_{gv}^{(1)}$$

$$G_{yzzx} = G_{dxy}^{(2)} + 2G_{gbz}^{(1)}$$

* Rank 4 tensor (ssa).

$$\begin{bmatrix} 0 & G_{xxyy} & G_{xxzz} & 0 & 0 & G_{xxxz} \\ -G_{xxyy} & 0 & -G_{xxzz} & 0 & 0 & G_{xxxy} \\ -G_{xxzz} & G_{xxzz} & 0 & 0 & 0 & G_{zzxy} \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ -G_{xxxy} & -G_{xxxy} & -G_{zzxy} & 0 & 0 & 0 \end{bmatrix}$$

$$G_{xxyy} = -2G_{dv}^{(3)} + 4Q_{f3}^{(1)}$$

$$G_{xxzz} = -G_{dv}^{(3)} - 4Q_{f3}^{(1)}$$

$$G_{xxxz} = G_{dxy}^{(3)} + 2Q_{fbz}^{(1)}$$

$$G_{zzxy} = G_{dxy}^{(3)} - 4Q_{fbz}^{(1)}$$

* Rank 4 tensor (aas).

$$\begin{bmatrix} G_{yzyz} & G_{yzzx} & 0 \\ G_{yzzx} & -G_{yzyz} & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$G_{yzyz} = 2G_{dv}^{(4)}$$

$$G_{yzzx} = 2G_{dxy}^{(4)}$$

* Rank 4 tensor (aaa). * Rank 4 tensor (sa).

$$\begin{bmatrix} 0 & 0 & G_{xxxy} \\ 0 & 0 & -G_{xxxy} \\ 0 & 0 & 0 \\ G_{yzyz} & G_{yzzx} & 0 \\ -G_{yzzx} & G_{yzyz} & 0 \\ 0 & 0 & G_{xyxy} \end{bmatrix}$$

$$G_{xxxy} = -2G_{dxy}^{(5)} + Q_{fbz}^{(2)}$$

$$G_{yzyz} = -G_{dv}^{(5)} + Q_{f3}^{(2)}$$

$$G_{yzzx} = -G_{dxy}^{(5)} - Q_{fbz}^{(2)}$$

$$G_{xyxy} = 2G_{dv}^{(5)} + Q_{f3}^{(2)}$$

* Rank 4 tensor (as).

$$\begin{bmatrix} 0 & 0 & 0 & G_{yzyz} & G_{yzzx} & 0 \\ 0 & 0 & 0 & -G_{yzzx} & G_{yzyz} & 0 \\ G_{xyxx} & -G_{xyxx} & 0 & 0 & 0 & G_{xyxy} \end{bmatrix}$$

$$G_{yzyz} = -G_{dv}^{(6)} + Q_{f3}^{(3)}$$

$$G_{yzzx} = G_{dxy}^{(6)} + Q_{fbz}^{(3)}$$

$$G_{xyxx} = -2G_{dxy}^{(6)} + Q_{fbz}^{(3)}$$

$$G_{xyxy} = 2G_{dv}^{(6)} + Q_{f3}^{(3)}$$

* Rank 4 tensor (s).

$$\begin{bmatrix} G_{xxxx} & G_{xxyy} & G_{xxzz} & 0 & 0 & G_{xxxy} & 0 & 0 & G_{xyxy} \\ -G_{xxyy} & -G_{xxxx} & -G_{xxzz} & 0 & 0 & G_{xxxy} & 0 & 0 & G_{xxxy} \\ G_{zzxx} & -G_{zzxx} & 0 & 0 & 0 & G_{zzxy} & 0 & 0 & G_{zzxy} \\ 0 & 0 & 0 & G_{yzyz} & G_{yzzx} & 0 & G_{yzyz} & G_{yzzx} & 0 \\ 0 & 0 & 0 & G_{yzzx} & -G_{yzyz} & 0 & G_{yzzx} & -G_{yzyz} & 0 \\ G_{xyxx} & G_{xyxx} & G_{xyzz} & 0 & 0 & G_{xyxy} & 0 & 0 & -G_{xyxy} \end{bmatrix}$$

$$\begin{aligned}
G_{xxxx} &= 2G_{dv}^{(1)} + 4G_{dv}^{(2)} + G_{gv}^{(1)} \\
G_{xxyy} &= -2G_{dv}^{(3)} + 4Q_{f3}^{(1)} \\
G_{xxzz} &= G_{dv}^{(1)} - G_{dv}^{(3)} - G_{gv}^{(1)} - 4Q_{f3}^{(1)} \\
G_{xxyy} &= G_{dxy}^{(1)} + 2G_{dxy}^{(2)} + G_{dxy}^{(3)} - 2G_{dxy}^{(5)} - G_{gbz}^{(1)} + 2Q_{fbz}^{(1)} + Q_{fbz}^{(2)} \\
G_{xxyx} &= G_{dxy}^{(1)} + 2G_{dxy}^{(2)} + G_{dxy}^{(3)} + 2G_{dxy}^{(5)} - G_{gbz}^{(1)} + 2Q_{fbz}^{(1)} - Q_{fbz}^{(2)} \\
G_{zzxx} &= G_{dv}^{(1)} + G_{dv}^{(3)} - G_{gv}^{(1)} + 4Q_{f3}^{(1)} \\
G_{zzxy} &= G_{dxy}^{(1)} + G_{dxy}^{(3)} + 2G_{gbz}^{(1)} - 4Q_{fbz}^{(1)} \\
G_{yzyz} &= -G_{dv}^{(2)} - G_{dv}^{(5)} + G_{gv}^{(1)} + Q_{f3}^{(2)} \\
G_{yzxz} &= G_{dxy}^{(2)} - G_{dxy}^{(5)} + 2G_{gbz}^{(1)} - Q_{fbz}^{(2)} \\
G_{yzyy} &= -G_{dv}^{(2)} + G_{dv}^{(5)} + G_{gv}^{(1)} - Q_{f3}^{(2)} \\
G_{yzxz} &= G_{dxy}^{(2)} + G_{dxy}^{(5)} + 2G_{gbz}^{(1)} + Q_{fbz}^{(2)} \\
G_{xyxx} &= G_{dxy}^{(1)} + 2G_{dxy}^{(2)} - G_{dxy}^{(3)} - G_{gbz}^{(1)} - 2Q_{fbz}^{(1)} \\
G_{xyzz} &= G_{dxy}^{(1)} - G_{dxy}^{(3)} + 2G_{gbz}^{(1)} + 4Q_{fbz}^{(1)} \\
G_{xyxy} &= 2G_{dv}^{(5)} + Q_{f3}^{(2)}
\end{aligned}$$

* Rank 4 tensor (a).

$$\begin{bmatrix} 0 & 0 & 0 & G_{yzyz} & G_{yzxz} & 0 & G_{yzyy} & G_{yzxz} & 0 \\ 0 & 0 & 0 & -G_{yzxz} & G_{yzyy} & 0 & -G_{yzyz} & G_{yzyz} & 0 \\ G_{xyxx} & -G_{xyxx} & 0 & 0 & 0 & G_{xyxy} & 0 & 0 & G_{xyxy} \end{bmatrix}$$

$$\begin{aligned}
G_{yzyz} &= 2G_{dv}^{(4)} - G_{dv}^{(6)} + Q_{f3}^{(3)} \\
G_{yzxz} &= 2G_{dxy}^{(4)} + G_{dxy}^{(6)} + Q_{fbz}^{(3)} \\
G_{yzyy} &= -2G_{dv}^{(4)} - G_{dv}^{(6)} + Q_{f3}^{(3)} \\
G_{yzxz} &= -2G_{dxy}^{(4)} + G_{dxy}^{(6)} + Q_{fbz}^{(3)} \\
G_{xyxx} &= -2G_{dxy}^{(6)} + Q_{fbz}^{(3)} \\
G_{xyxy} &= 2G_{dv}^{(6)} + Q_{f3}^{(3)}
\end{aligned}$$

* Rank 4 tensor (t).

$$\begin{bmatrix} G_{xxxx} & G_{xxyy} & 0 \\ G_{xxyx} & -G_{xxxx} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & G_{yzyz} \\ G_{zzxx} & G_{zzxy} & 0 \\ G_{xxyx} & -G_{yzyz} - G_{zzxx} & 0 \\ G_{yzxz} & G_{yzyy} & 0 \\ 0 & 0 & G_{zzxz} \\ -G_{yzyy} - G_{zzxz} & G_{xyyy} & 0 \\ 0 & 0 & -\frac{G_{xxxu}}{2} - \frac{G_{xxyx}}{2} + G_{xyyy} + G_{zzxy} \end{bmatrix}$$

$$G_{xxxx} = 2G_{dv}^{(1)} + 4G_{dv}^{(2)} + G_{gv}^{(1)}$$

$$G_{xxyy} = G_{dxy}^{(1)} + 2G_{dxy}^{(2)} + G_{dxy}^{(3)} - 2G_{dxy}^{(5)} - G_{gbz}^{(1)}$$

$$G_{yyzz} = -G_{dv}^{(1)} + G_{dv}^{(3)} + G_{gv}^{(1)}$$

$$G_{zzxx} = G_{dv}^{(1)} + G_{dv}^{(3)} - G_{gv}^{(1)}$$

$$G_{zzxy} = G_{dxy}^{(1)} + G_{dxy}^{(3)} + 2G_{gbz}^{(1)}$$

$$G_{xxyx} = G_{dxy}^{(1)} + 2G_{dxy}^{(2)} + G_{dxy}^{(3)} + 2G_{dxy}^{(5)} - G_{gbz}^{(1)}$$

$$G_{yzzx} = G_{dxy}^{(2)} - G_{dxy}^{(5)} + 2G_{gbz}^{(1)}$$

$$G_{yzyy} = -G_{dv}^{(2)} + G_{dv}^{(5)} + G_{gv}^{(1)}$$

$$G_{zxxz} = G_{dv}^{(2)} + G_{dv}^{(5)} - G_{gv}^{(1)}$$

$$G_{xyyy} = G_{dxy}^{(1)} + 2G_{dxy}^{(2)} - G_{dxy}^{(3)} - G_{gbz}^{(1)}$$