Exercises

5 May 2009

Inelastic X-ray Scattering

1. Is it possible to build a monochromator with an energy resolution of 2meV at around 10keV? What are the technical challenges?
2. Why would one want to have an energy resolution of 2meV at 10keV, if it is much easier to do it at 17.793keV?
3. Energy-scans with a conventional high-resolution monochromator are performed by scanning the temperature of the monochromator. What are reasonable temperature differences? What does it mean for the energy difference?
4. The energy-resolution of Si-reflections gets better for higher indexed reflections for x-rays. Show that the energy resolution is constant for neutrons
5. Phonons are related to the thermal expansion. Show that an asymmetric term in the potential is required for thermal expansion ($U=ax^2-bx^3-cx^4$)
6. Calculate the energy of the plasmon in Li for q=0. How does it change if pressure is applied?

   Lattice constant of Li: 3.21Å
   density: 0.53 g/cm³
   bcc lattice
   change of lattice constant with pressure (up to 7.5GPa)

P (GPa)	V_{atom}^{bcc} (Å³)	P (GPa)	V_{atom}^{fcc} (Å)
0	21.6225	7.50	15.1251(18)
1.48	19.4053(14)	8.35	14.7514(18)
2.16	18.6813(42)	9.08	14.4558(20)
2.68	18.1667(31)	9.83	14.1789(28)
2.94	17.9452(23)	11.10	13.7842(26)
3.16	17.7704(21)	13.01	13.1857(21)
3.40	17.5503(24)	14.00	12.9326(27)
4.31	16.8928(31)	14.60	12.7879(33)
5.16	16.3439(20)	16.10	12.4137(21)
5.55	16.1220(20)	18.00	12.0048(24)
5.96	15.9002(21)	20.05	11.6082(25)
6.96	15.3847(27)	20.05	11.5971(35)
7.50	15.1491(40)	21.10	11.4371(20)

Hanfland et al.,
Sol. State Comm. **112**
123-127 (1999)