Name: _____

Advanced Solid State Physics — Prof. Dr. W. Kuch
Winter semester 2014
3rd exercise sheet

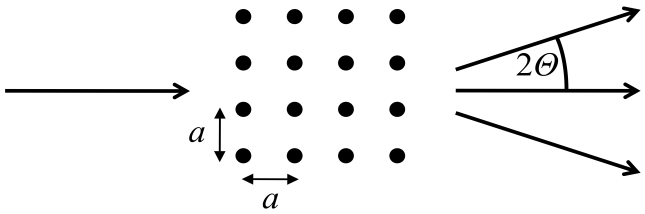
Submission: Tuesday, 04. November 2014, before the lecture
(or drop until 10 o'clock on the same day in mailbox between rooms 1.2.38 and 1.2.40)

7. Debye–Scherrer diffraction experiment (**) (4 points)

In what is called a "Debye–Scherrer diffraction experiment" monochromatic X rays transmit a powderized sample, and the diffracted intensity is recorded on a detector/photographic plate behind the sample. Alternatively, this powder sample can be mounted in a two-circle diffractometer to perform a Θ–2Θ scan and to obtain the same result.
Calculate the angles 2Θ of the diffraction maxima that appear if the experiment is performed with Cu K_α radiation ($\lambda = 1.54$ Å) on W powder and the angle 2Θ between the incoming and the diffracted beam is limited to $20° \leq 2\Theta \leq 85°$. W has a *bcc* crystal structure with $a = 3.17$ Å.

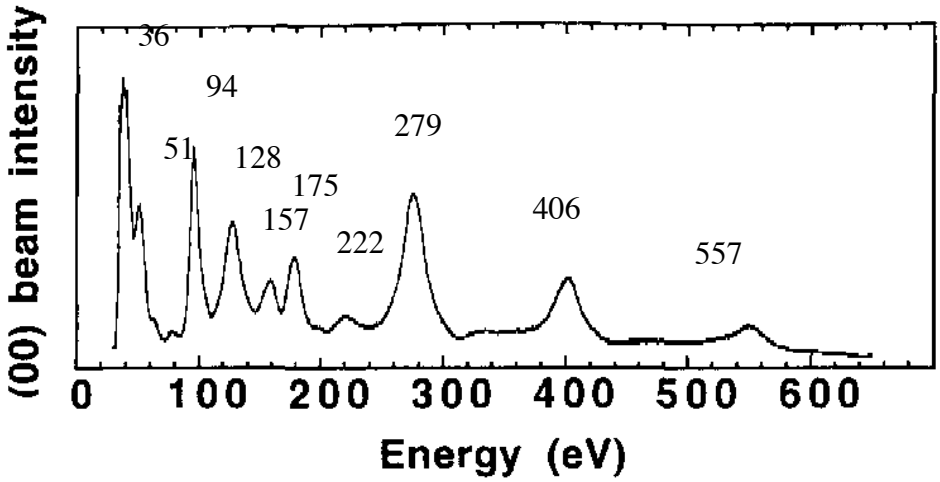
8. Laue diffraction experiment (***) (4 points)

In what is called a "Laue diffraction experiment" polychromatic X rays transmit a single-crystalline sample, and the diffracted intensity is recorded on a detector/photographic plate behind the sample. Let us here, for simplicity, only consider a two-dimensional cut through this experiment. In this plane the sample represents a simple quadratic lattice with lattice constant $a = 2.50$ Å, and the X rays enter along the [10] direction (see sketch). Calculate the angles 2Θ under which diffraction spots are observed in this plane if the maximum photon energy of the X rays is 25 keV.



9. Kinematic analysis of LEED diffraction intensities (**) (4 points)

The figure overleaf shows a LEED-IV curve of an unknown crystal. Which layer distance perpendicular to the surface results from the kinematic analysis of the single-scattering peak maxima?
Proceed in the following way: Identify first those peaks that correspond to single-scattering Bragg maxima by using the labeled energy values and an inner potential of 10 eV. Calculate then from the Bragg condition the layer distance for a scattering angle of $\Theta = 90°$ (ideal backscattering geometry).


(00) beam intensity
36
94
51
128
175
157
222
279
406
557
0
100
200
300
400
500
600
Energy (eV)