Notes for IXS Studies of Liquid and Glass Dynamics

AB, February 2013, and more recent. Based on long experience with many users, and, especially, careful work with D. Ishikawa.

Reduction of Backgrounds:

1. Please use *single crystal windows* on the sample container to avoid SAXS from polycrystalline materials or WAXS from glasses. Diamond and sapphire are good choices as they have fast sound velocities so that acoustic modes tend to disperse quickly, and are often out of the interesting range of energy transfers for liquids, at least for low Q. However, at higher Q, crystal modes may disperse back into the liquid energy window, so care is needed. Also, the exact position of modes from crystals will depend on the orientation of the window (not only the magnitude of Q), so to measure backgrounds properly, the window orientation must be the same (including azimuthal angle) within a few degrees for measurements of empty cells and of filled cells. This is generally more sensitive at higher Q, and for those interested particularly in high Q work, probably diamond is better than sapphire as its phonon spectrum is simpler.
2. Placing a *pinhole of 0.3 or 0.4 mm diameter just in front of the sample cell* (and inside vacuum, if it is used) is highly desirable for reducing background at low momentum transfers.
3. If the arrangement is a sample cell inside of a vacuum chamber, it is desirable that the vacuum chamber also have single crystal windows. This may be relaxed if the pinhole (2) is used, and somewhat depends on geometry, desired momentum transfer range, etc.

Sample Thickness:

At small momentum transfers, the sample thickness should generally be 1 attenuation (1/e) length for optimum signal. If this is not possible, slightly more (say 1 to 2 attenuation lengths) can be better for S/N ratio. Note that thicknesses > 2 attenuation lengths will waste beam time, and should be avoided. Also, sample thickness >10 mm is probably not a good idea.

At finite (Q>0) momentum transfers, one must insure the sample thickness does not adversely affect the geometrical setup of the spectrometer. This means that the projection of the sample thickness perpendicular to the direction of two-theta should not be too large : i.e.: $t = L \sin(2\Theta)$, where L is the sample thickness along the beam and 2Θ is the scattering angle, must not be too large. I suggest $t < 0.5$ mm to be generally safe, and $t<1$ mm always. If you want to be in the range of $0.5 < t < 1.0$ mm, you should probably check during the expt that the resolution is not adversely affected, at least at the (11 11 11).