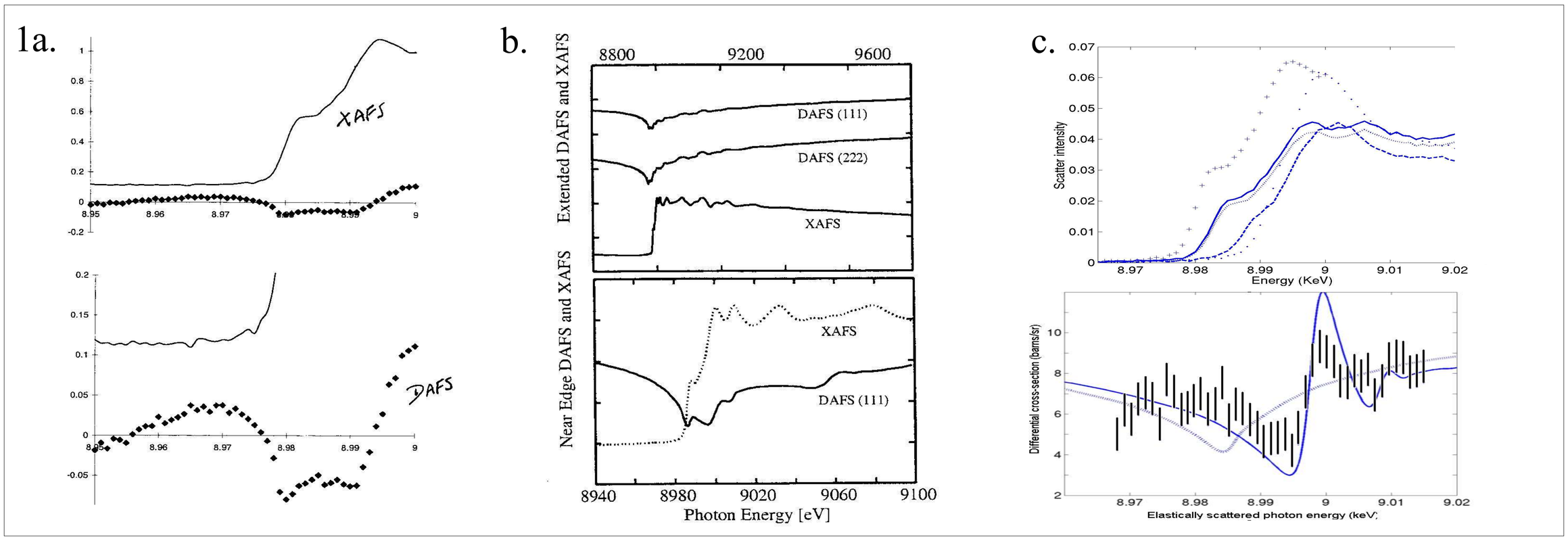
Near-edge elastic photon scattering in dilute amorphous systems

Richard P. Hugtenburg*[1,2], David A. Bradley[3] and David England[2]

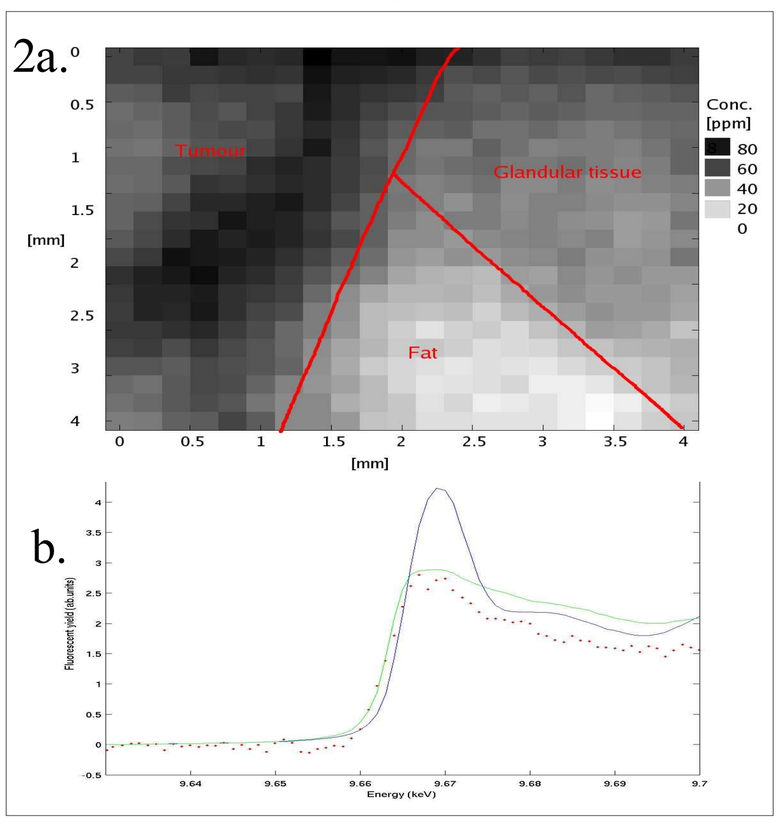
**Email address of corresponding author:* r.p.hugtenburg@bham.ac.uk

1. School of Physics and Astronomy, University of Birmingham, B15 2TH, U.K.
2. Queen Elizabeth Medical Centre, University Hospital Birmingham, B15 2TH, U.K.
3. School of Physics, University of Exeter, EX4 4QL, U.K.

Direct measurement of the elastic photon scattering cross-section has been performed for several transition metals and their ions at XMAS (BM-28) in order to assess the validity of independent particle approximation (IPA) atomic theories in amorphous environments.

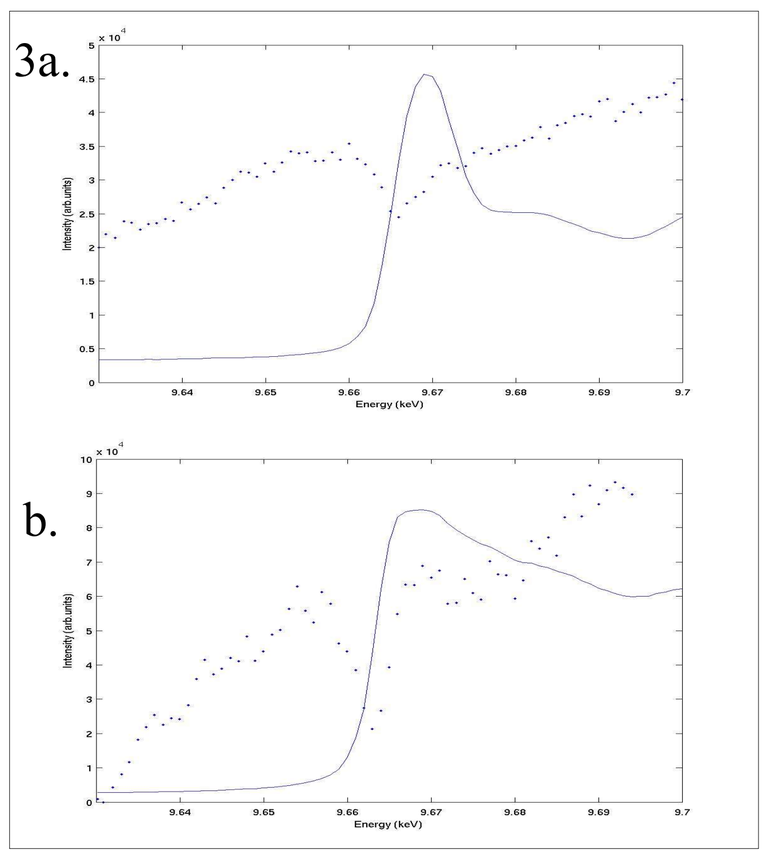


Direct measurements of scattering in vapour deposited Cu metal (Figure 1 a) compare well with intensities obtained via interferometry, e.g. b) Stragier et al., PRL 69, 3064 (1992). c) Variation in XANES spectra determined from fluorescence yield for Cu metal (+), Cu 2+ ions (o) in aqueous solution and several different batches of Cu-doped sol-gel glass demonstrate the sensitivity of the method to changes in charge state. This data and predictions for elastic scattering cross-sections for neutral (light blue) and Cu 2+ ions (dark blue) suggest that aqueous solutions are the most favourable conditions for testing IPA theories.



Recent synchrotron based XRF analysis of trace elements in cancerous human tissue has demonstrated high concentrations of metals such as Zn in regions that are identified as tumour. Changes in the nutrient supply can explain some of the noted increases but could also be due to a Zn bearing macromolecular protein, MMP-2, or gelatinase, which has been associated with the infiltration of tumour (metastasis) into non-diseased tissue. Figure 2(a) shows sub-mm variation in the fluorescent yield of Zn in wax-mounted tumour-bearing tissue suggests that the highest concentrations of Zn occur on the boundary with normal tissue.

In figure 2(b) XANES spectra for Zn ions in water (red), sol-gel glass (green) and tumour (blue) support the contention that a component of Zn is non-nutrient in origin and is therefore potentially associated with the presence of MMP-2



Direct measurements of the elastic scattering signals from Zn ions in aqueous solution (figure 3a) and b) sol-gel glass in comparison with XANES data suggest that the determination of the elastic scattering minimum is potentially more sensitive to variations in the ionic state than chemical shift.

These results suggest that an imaging method that combines fluorescence with small-angle elastic scattering is a sensitive probe of metastatic growth, data that would be highly valuable to a surgeon prior to curative medical intervention.