Total Reflection Energy Dispersive X-ray Fluorescence for Analysis of Human Samples: from Cells to Tissues

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Due to their unique and customizable optical and physical properties, nanoparticles are being investigated for a wide variety of applications. Amongst these nanoparticles, gold nanoparticles are being used in nanomedicine as dose enhancers and drug carriers in cancer therapy. In addition, the biocompatible nature of gold nanoparticle has allowed for early phase clinical trials. Further advancement of nanomedicine requires quantification to understand and investigate factors that affect cellular uptake and transport of nanoparticles.

We have developed and validated a Total Reflection X-ray Fluorescence (TXRF) based method for quantification of trace-level gold nanoparticles accumulated in cancer cells. The spectrometer used employs a molybdenum target X-ray tube, SDD detection system and quartz sample carriers (S2 PicoFox, Bruker-AXS, USA). To date, gold was investigated, in the form of a standard solution, solid nanoparticle and accumulated in cancer cells.

The use of bench-top, low power total reflection X-ray fluorescence (TXRF) spectrometry for the quantification of elements in human tissues is presently limited in nanomedicine; although, the *ex vivo* TXRF measurements of any tissue provides multi-elemental analysis, which could help diagnose or monitor a medical condition or environmental exposure to many trace and toxic elements. Besides only recent availability of these low power spectrometers, the particular challenges presented by the complex biological samples, such as human cells and tissues, could be influencing their limited use. In this presentation, we will discuss constraints imposed by the use of TXRF, together with a brief description indicating the range of tissues for which such analyses have been or could be established.