A NEW ERA IN SURFACE ANALYSIS

CHEMICAL INFORMATION NEVER SEEN BEFORE!

CSMA

CSMA Ltd has been at the forefront in the application of Surface Analysis (SA) techniques to a vast range of manufacturing, product development and research problems for over twenty years. A recent **quantum leap** in SA technology will open up a whole **new area** in **molecular characterisation of materials** especially in the areas of :-

- **Healthcare products**
- **Medical devices**
- **Drug delivery systems**
- **Hair-care**
- **Fibre technology**
- **Coatings**

This new technology employs a gold liquid metal ion source which is tuned to deliver single or poly-atomic species to the sample surface. In combination with a time of flight mass spectrometer (ToFSIMS), the use of Au_2^+ or Au_3^+ clusters produces an improvement in sensitivity by up to 100 times, compared to current instruments. In brief, the features and benefits to industry are :-

FEATURES

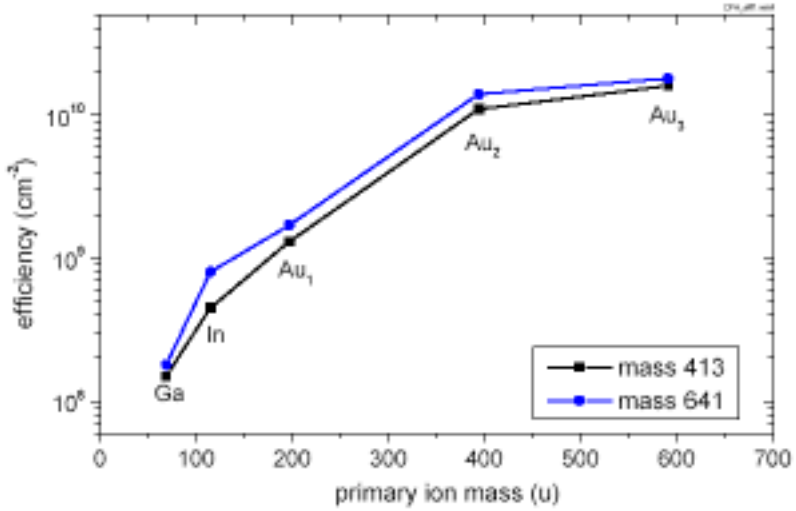
- Chemical mapping of complex inorganic/organic materials with feature sizes down to 200nm
- Unequivocal identification of surface treatments, additives, excipients and active drug components
- Retrospective mass spectral and imaging analysis of complex surfaces using **Region of Interest** mode.

BENEFITS

- Previously unseen surface chemical information.
- Better identification of chemical defects, locus of failure and contamination issues.
- Improved data for product development, failure analysis, migration studies and patent defence / litigation.

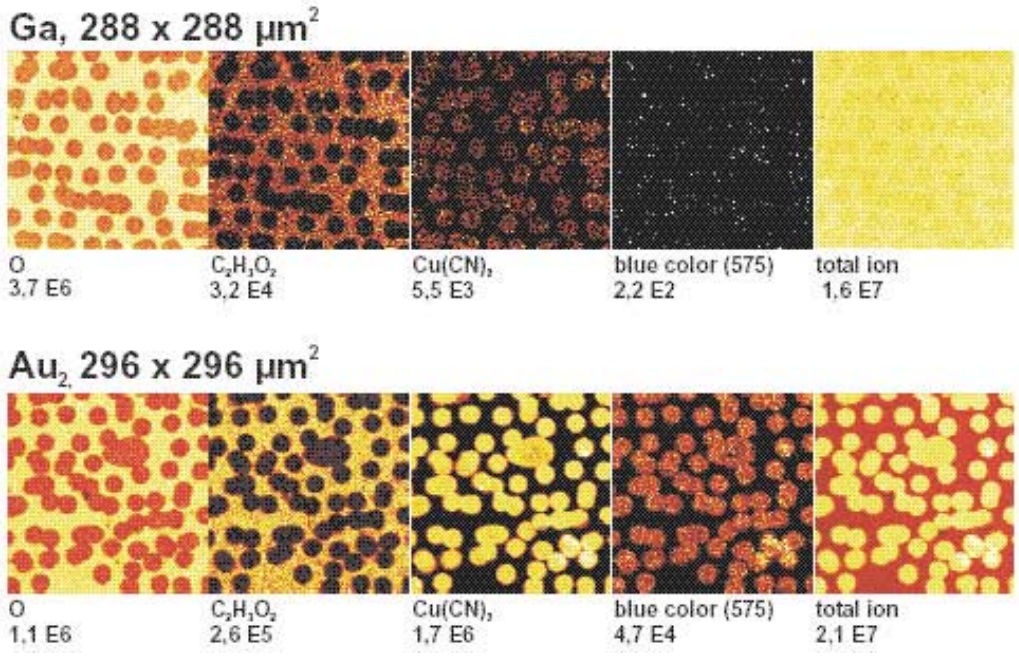
IMPROVED ANALYTICAL SENSITIVITY WITH AU - SOURCE ToFSIMS

It has been known for many years that the heavier the primary ion species in SIMS, the greater the efficiency of secondary ion production. A gold liquid metal ion source can be tuned to contain Au_1, Au_2 or Au_3 cluster ions producing heavy bombardment species and an increase in sensitivity of 10 - 100 times compared to conventional sources (e.g. gallium - see graph). This effect, combined with the ability to resolve surface features as small as 200nm, now provides SIMS experts with the most significant advance in instrumentation for ten years



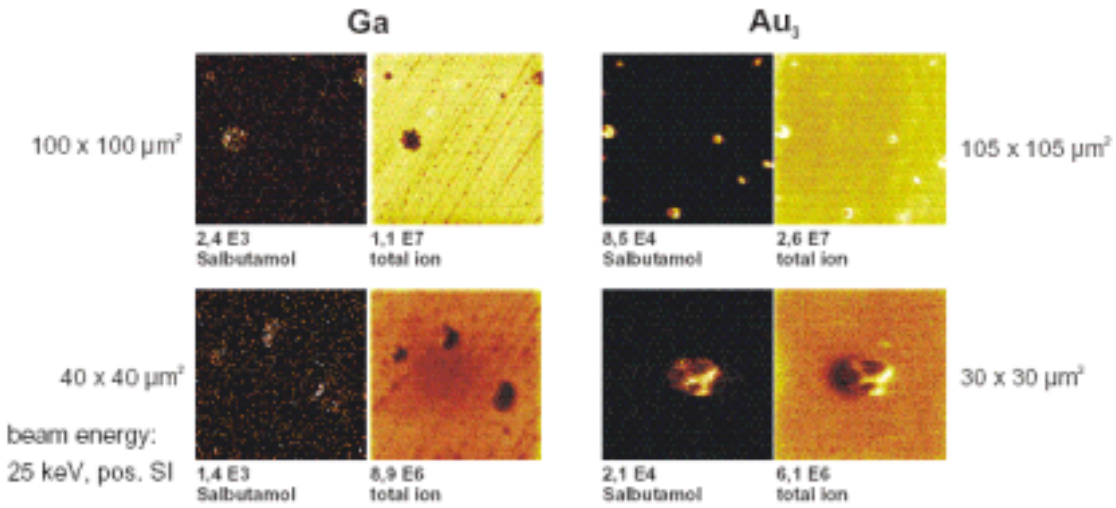
CCD BLUE COLOR FILTER ARRAY

The image data from a CCD Blue Colour filter array shows a comparison of Ga^+ and Au_2^+ bombardment. There is a significant increase in signal, particularly for the m/e 575 blue colour ion. The graph (above) summarises the efficiency gain when using a gold source.



DRUG DELIVERY SYSTEM - SALBUTAMOL DRY INHALANT FORMULATION

Secondary ion images, monitoring the molecular ion from salbutamol at m/e 240, from an inhalant dispenser sprayed on to a silicon substrate, reveal a drug-coated lactose granule approximately 10µm in diameter - **only visible with the gold source.**



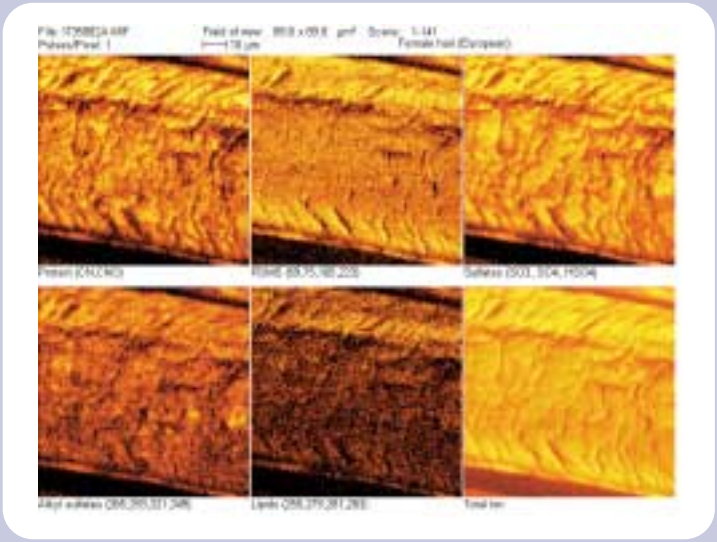
SURFACE ANALYSIS OF HAIR

Modern hair-care products include a wide range of shampoos, conditioners, styling products and colourants. The chemistry of each product is complex and formulated to bring a specific cosmetic effect e.g. cleansing, shine, lustre and thickening. For example, a proprietary shampoo product may contain cleansing agents (surfactants), conditioners, functional additives, preservatives, aesthetic additives and medically active ingredients.

Increasingly, the development of effective hair treatments relies on a detailed knowledge of the surface chemistry of the hair and the effect of the various ingredients of the formulation on hair structure. For example, the effects of additives on the surface lipid structure is one area of ongoing investigation. The surface sensitivity and detailed chemical information available from techniques such as X-Ray Photoelectron Spectroscopy (XPS) and Time of Flight SIMS (ToFSIMS) are well known and are now routinely applied to hair characterisation problems. Recent developments in ToFSIMS technology, utilising gold cluster ions as primary ion species, have opened up a whole new area of detailed chemical information previously unavailable from the relatively small surface areas associated with individual hair fibres i.e. typically less than 70µm x 70µm.

In the example below, ToFSIMS analysis in mass spectral and high-resolution imaging analysis modes, have been used to characterise the surface of a human hair.

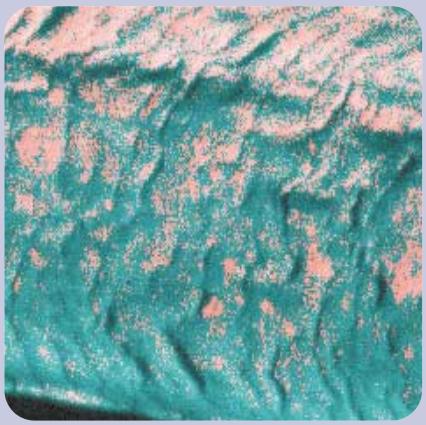
ToFSIMS mass spectral analysis identified the presence of the following components on a single hair fibre :-



- Protein, detected as CN^- and CNO^-, from keratin
- Polydimethyl-siloxane (PDMS) and quaternary ammonium compounds from conditioning agents
- Alkyl sulfates from surfactant additives
- Lipids, detected as palmitate, oleate, stearate and 18-methyleicosanoate species, from the hair structure
- Sodium, potassium and calcium

The ToFSIMS images (above - thermographic colour scale) from a single hair fibre show the relative distribution of protein, PDMS, sulfates, alkyl sulfates and lipid character (palmitate species). Note that the physical structure of the hair including cuticle scale is clearly visible, particularly in the total ion image.

The overlay image (right) shows the more localised distribution of alkyl sulfate residues (red) compared to the total ion image (cyan).



CSMA provides a complete surface analysis service to industry to accommodate every level of demand:

- Rapid turnaround analysis (24 hours)
- Problem solving and failure analysis
- Litigation and expert witnesses
- Training courses
- Reverse engineering and competitor analysis
- Materials and product development
- Patent registration / infringement

For further information contact our Head Office at:
CSMA Ltd, Queens Road, Penkhull, Stoke on Trent, Staffordshire, UK ST4 7LQ
Tel: +44 (0)1782 764440 Fax: +44 (0)1782 412331
Email: enquiries@csma.ltd.uk Website: www.csma.ltd.uk

CSMA
experts in surface technology

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