OAK RIDGE NATIONAL LABORATORY
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Tip-Enhanced Laser Ablation Directly into a Surface Liquid Junction

Disclosure Number

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Technology Summary

Tip-Enhanced Laser desorption (LD) or ablation (LA) in transmission or reflective geometry, at an acute, right or obtuse angle, directly into a liquid junction at the surface of interest that is formed between a solvent dispensing and retrieving AFM probe and the surface. These processes take place under ambient conditions or possibly in a controlled environment. Analysis is necessarily limited or specific for material that is not dissolved simply by contact of the solvent to the surface – this distinguishes the method from our other liquid extraction surface sampling probe approaches. Can be a wall-less liquid junction formed using AFM probe or a sealing/suctioning AFM probe. The ablated surface material collected in the liquid is available for further processing or direct analysis by one or more techniques including spectroscopic and mass spectrometric methods or others. The AFM probe can operate in a an autonomous droplet dispensing and retrieving fashion or as a continuous flow device. Autonomous dispense configurations provides means to efficiently collect the ablated material from submicron sized craters for direct analysis as well as for further processing, such preconcentration, cleanup or material separations, before any analysis Continuous flow configurations provide for immediate and continuous analysis of the ablated material collected in solution at any point above the ablation region in the liquid junction and along the length of the transport tubing to an end detector or waste Allows for simultaneous collection of multimodal information, by using an AFM to provide physical information about a surface, and chemical information from the desorbed material. One embodiment would be LA into a liquid junction formed between the AFM probe and the surface with the liquid analyzed using an inductively coupled plasma mass spectrometer (ICP-MS) for elemental determination of the ablated material. With mass spectrometry as a detection system the method might also be used with electrospray ionization (ESI) or atmospheric pressure chemical ionization (APPCI) or other if the material ablated from the solvent intractable surface is of the size range and chemical characteristics appropriate to be ionized by these methods and molecular information is desired. Concept provides co-registration of topography, bulk modulus, material stiffness, electrochemical strain, as well as position and chemical signal so multimodal nanoscale imaging is possible.

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