

Raman-Spectroscopy – A powerful tool for life- and material-sciences

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Raman spectroscopy has emerged in the last years as an extremely powerful method in almost all natural science disciplines. This renaissance of Raman spectroscopy was mainly triggered by the latest achievements in laser technology, by the design of very efficient filter to suppress the elastically scattered Rayleigh light, and by the development of extremely sensitive detectors. The advantages of Raman spectroscopy are its unprecedented high specificity and its versatility. Raman spectroscopy is a non destructive technique and does in general, require only minimal or no sample preparation. Solid, liquid, and gaseous samples can be measured as well as transparent or non transparent samples or samples with different surface textures *i.e.* Raman spectroscopy can be applied to any optical accessible sample, where a pre-treatment of the sample is not necessary.

In this presentation a report on a Raman spectroscopic characterization of a broad variety of biological probes will be given. Raman spectroscopy is an extremely capable, suitable and prominent method for probing the relationship between structure, dynamics and function of biomolecules. In this context micro-Raman imaging, the surface enhanced Raman scattering (SERS) technique and resonance Raman spectroscopy are commonly applied. These Raman techniques allow one to characterize the structure of *e.g.* isolated pharmacological relevant substances and the investigation of biological tissues *i.e.* monitoring of low concentrated active components in plants and especially the localization of pharmaceutical relevant substances in tissues. Not only the localisation but also the investigation of the mode of action of drugs against infectious diseases on a molecular level will be presented. In addition Raman spectroscopy also allows the identification of microorganisms on a single cell level.

The main focus within the second major topic material photonics is concerned with the derivation of structure-property as well as structure dynamics relationships by means of Raman spectroscopy. In particular the characterization of mineralogical samples like *e.g.* extraterrestrial material (meteorites) and the derivation of structure-activity and dynamic relationships in artificial light harvesting systems or photocatalysts based on Ruthenium-polypyridyl complexes by means of resonance Raman spectroscopy will be presented.

In summary the presented examples convincingly demonstrate the great capabilities of Raman spectroscopy for life and material sciences making this technique to one of the most essential laser spectroscopical methods.

Experimental evidence for rapid re-equilibration of water between melt inclusions in olivine and host magma

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Here we report the results of pilot experimental study aimed at evaluating the ability of olivine to protect melt inclusions at changable external conditions, which may readily take place in long-living magmatic systems.

For the experimental study, natural olivines containing glassy inclusions were picked from olivine-plagioclase-pyroxene phyric submarine tholeiitic basalts from the Galapagos Plateau (sample PL02-24-33 provided by D.Christie). Ninety six inclusions from this sample were preliminarily studied for major and trace elements. Water content in natural inclusions measured by ion probe ranged from 0.37 to 0.67 wt % (n=20) and was similar to matrix glass (0.43 wt %). Selected olivine grains (0.5-1 mm) with inclusions inside were loaded in Fe-preturated Au₈₀Pd₂₀ capsule together with reduced (QFM-1) powder of depleted synthetic MORB. The mixture was dopped with ~ 3 wt % of distilled water. Experiments were conducted in internally heated pressure vessel at 200 MPa and 1140 °C using Ar as pressure medium. The run duration was 48 hours.

Experimental products were studied optically, with electron and ion probe. Surprisingly, all of seven inclusions analysed after experimental treatment had high water content (2.0-2.7 wt%), close to the matrix glass (2.3 wt%) and ~5 times higher than in starting compositions and exhibited high MgO (8.1-8.9 wt% vs. 4.0-6.7 wt % prior experiment) corresponding olivine-melt inclusion equilibria at hydrous conditions. Incompatible trace elements, S, F and Cl content in the melt inclusions decreased only slightly after the experiment (due to host olivine dissolution), remaining within the range of natural Galapagos inclusions and ~10 times higher than in depleted synthetic matrix.

We conclude from this study that melt inclusions in olivine behave as semi-closed system at changing external conditions. Complete re-equilibration of water between inclusions in large olivines (up to 1mm in size) and matrix melt is achieved during 2 days or less, whereas incompatible trace elements and other volatile components (S, Cl, F and likely CO₂) behave as immobile. Rapid water (hydrogen) exchange between inclusions in olivine and host magma, which is faster than Fe-Mg diffusion in olivine, implies that those inclusions experienced detectable Fe-Mg re-equilibration with olivine can unlikely preserve initial water concentrations and most likely reflect water content in surrounding magma prior eruption.