

RAMAN SPECTROSCOPY OF ROCKS IN THIN SECTIONS: ANALYTICAL CONSTRAINTS

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Raman spectroscopy is a well-known technique used for the fingerprinting of mineral substances. The Raman technique can be well adapted for studies of thin sections of rocks and minerals. If the Raman spectroscopic determination of minerals in thin sections is made as a routine procedure, both sample properties and individual characteristics of studied crystals constrain the resulting information. The main constraints are discussed below.

1. Constraints caused by properties of minerals and mineral aggregates.

1a. Some characteristic Raman bands of minerals reveal strong depolarization ratios. In this case the effectiveness of the Raman fingerprinting strongly depends on the spatial orientation of crystallographic axes in a grain of the studied mineral. In case of textured samples (in many metamorphic, some magmatic rocks and also vein aggregates) the Raman fingerprinting will depend on the orientation of the rock by which the thin section was produced. The effect of crystal orientation cannot be fully eliminated. It can be reduced by measuring of depolarized scattered light.

1b. The topology of the Raman spectrum can differ according to the retardation of the crystal. Birefringence causes the rotation of polarization plane of the scattered light. It is especially important for structural studies (order/disorder phenomena, phase transformations). If crystals are zoned with the variable retardation in different zones, false conclusions about the breaking of symmetry selection rules can be made. To avoid such artefacts the observation in depolarized light can be used. By the polarized exciting light the measurement with the crystal in position of optical extinction can be used.

1c. Luminescence from the studied mineral and from the surrounding matrix causes the common constraints by Raman fingerprinting. This phenomenon is well-known and will be not considered here.

2. Constraints caused by the nature of sample. Rock thin sections are mounted on glass plates using special types of organic glue (Canadian balsam etc.). The excitation area when using conventional non-confocal microscope-based Raman systems can be large enough to partially include the glue layer. It can result in strong background luminescence, heating and evaporation of glue, which makes Raman observation impossible.

The outlined analytical problems demonstrate that a careful mineralogical examination of a thin section must be made before the Raman investigation can be carried out. The microscope attached to the Raman spectrometer must be equipped with a transmitted light illumination system, rotating stage and a set of polarizers for visible light. Confocal microscope geometry is desirable. A depolarizer (i.e., $\lambda/4$ plate) for the scattered laser light is required.

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