RAMAN IMAGING OF UREILITIC DIAMONDS. A. Karczemska[1] and T. Jakubowski[2], [1]Technical University of Lodz, Institute of Turbomachinery, Wolczanska 219/223, Lodz, Poland (anna.karczemska@p.lodz.pl); [2]Technical University of Lodz, Institute of Materials Science and Engineering, Stefanowskiego 1/15, Lodz, Poland (illaenus@gmail.com);

Introduction: Ureilites belong to the group of meteorites called primitive achondrites [1]. Beside olivines and pyroxenes, ureilites contain up to 6% carbon, represented primarily by graphite and diamonds. Diamonds are usually of um sizes (2 – 10 um) but smaller, nanometer sizes diamonds have also been detected by different authors. The Raman shift of monocrystalline cubic diamond is 1332.5 cm $^{-1}$, however, different Raman shifts have been obtained for ureilitic diamonds, with different FWHM parameters [2,3].

Experiments: Polished slices of three ureilites with different shock levels were used in our study: JaH 054, DaG 868 and NWA 3140.
The 2D imaging was done with a Confocal Raman Imaging alpha 300 R WITec apparatus equipped with a Nd:YAG laser with 532 nm excitation. The spectra was collected with a high-sensitive confocal microscope connected to a high-throughput spectrometer equipped with a CCD camera.

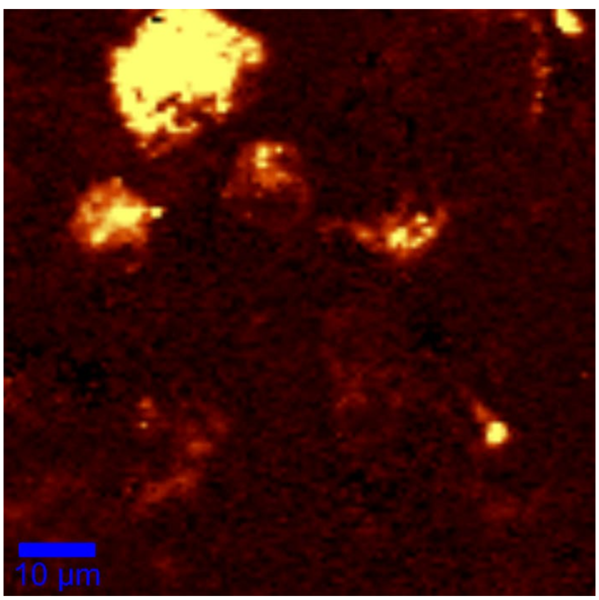

Figure 1. Distribution of diamonds in ureilite JaH 054 byRaman imaging. Brighter colour indicates a higher intensity of diamond peak, shift positions are from 1297 cm $^{-1}$ to 1332 cm $^{-1}$.

The examined areas chosen were in the carbonaceous veins of the ureilites and they were measured in the Spectral Imaging Mode with the example scan range 30 µm x 30 µm and 120 x 120 pixels (=14400 spectra) with an integration time of 102 ms per spectrum.

Results: Examination of the Raman results show the coexistence of several diamond types based on the various observed shift positions in the studied samples. Shifts from 1297 cm $^{-1}$ to 1344 cm $^{-1}$ were obtained.

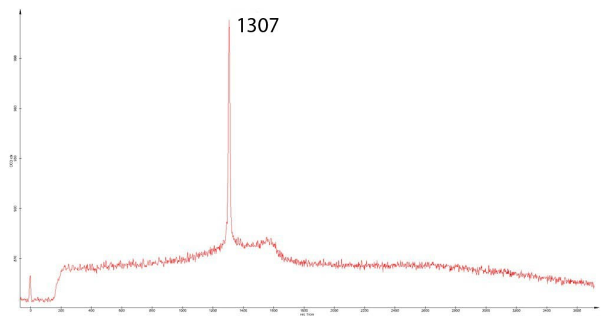

Figure 2. Example of raw Raman spectra of the JaH 054 ureilite. Shift position of diamonds is 1307 cm $^{-1}$.

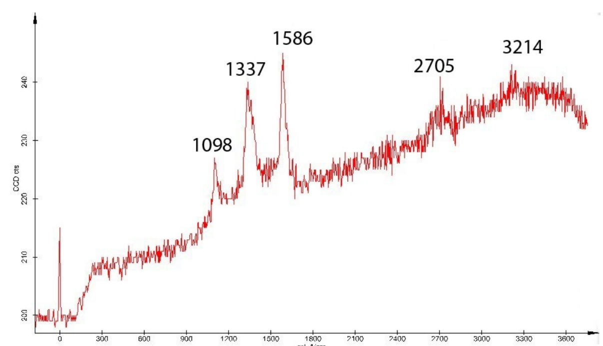

Figure 3. Example of raw Raman spectra form NWA 3140 ureilite. Shift position of diamonds is 1337 cm $^{-1}$.

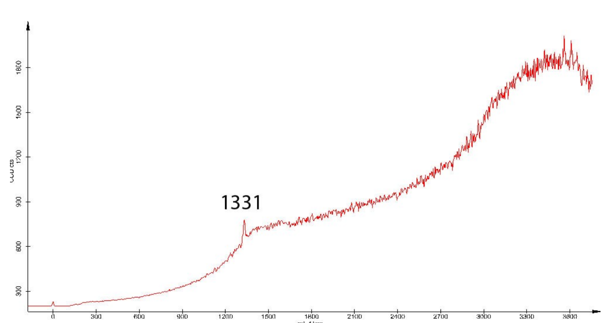

Figure 4. Example of raw Raman spectra form DaG 868 ureilite. Shift position of diamonds is 1331 cm $^{-1}$.

Also of note is the occurance of different Raman shifts inside a single diamond cluster (bright areas at Fig. 1.). Such diamond clusters contain a variety of diamonds of different sizes and different Raman shifts. Figure 1 shows the example diamonds distribution for JaH 054, similar results were obtained for all samples. Figures 2-4 show the example raw Raman spectra of three examined samples. However, high diversity of results can't be included in such short article.

Different carbon phases have been detected in examined ureilites. What is particularly interesting is the apparent coexistence of diamonds with distinct and varying Raman shifts in such a small area of each sample. In the most cases diamonds coexist with graphite, but sometimes only a diamond peak is present. The Raman peak positions in some cases are shifted towards smaller wavenumbers. This could indicate the presence of different diamond polytypes [4] or the presence of nanodiamonds in the sample [5]. The smallest diamonds detected by the authors are about 300 nm in diameter. Unfortunatley, with the method utilized, it is not possible to recognize smaller objects.

Some diamond peaks are shifted towards bigger wavenumbers: 1334 - 1344 cm^{-1}. This could indicate the presence of diamond polytypes or the presence of internal stresses inside diamonds crystals.

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References:

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