MICRO-RAMAN SPECTROSCOPY OF HAH 286 EUCRITE. M. Szurgot[1] and A. Tomasik[2], [1]Lodz University of Technology, Center of Mathematics and Physics, Al. Politechniki 11, Lodz, Poland, (mszurgot@p.lodz.pl), [2]Lodz University of Technology, Center of Mathematics and Physics, Al. Politechniki 11, Lodz, Poland.

Introduction: Hammadah al Hamra 286 is one of Saharian eucrites found in Lybia in 2000 [1]. Elemental composition, mineral composition and microstructure of HaH 286 meteorite were recently studied by analytical electron microscopy [2]. It was established that the HaH 286 meteorite is a pyroxene-plagioclase basaltic achondrite, the non-cumulate eucrite with the broad composition of plagioclase [2]. The aim of this paper was to identify and characterize meteorite minerals, and to determine pyroxene composition by micro-Raman-spectroscopy.

Experimental: Raman spectra were recorded at room temperature in back scattering geometry using confocal Raman micro-spectrometer T-64000 (Jobin-Yvon) equipped with the BX-40 microscope (Olympus). To excite the sample minerals Ar laser was applied (514.5 nm Ar line, the beam diameter about 1 μm), and acquisition time and laser power were adjusted to obtain spectra of sufficient quality. To identify minerals the Raman spectra were compared with the literature data, and chemical composition of pyroxenes and the feldspar group were determined on the basis of literature data on Raman spectra features and calibration of spectral peak positions [3-6].

Results and discussion: Figure 1 shows a BSE image and figure 2 an optical image of HaH 286. The images reveal major characteristics of the achondrite: the presence and domination of pyroxene and plagioclase crystals, and the texture typical of pyroxene-plagioclase achondrites known as eucrites.

Analytical electron microscopy shows that two main meteorite minerals have the mean composition: clinopyroxene En34Fs59Wo7 (pigeonite), plagioclase feldspar An88Ab12, and composition range is as follows: pyroxene En34-36Fs53-62Wo3-13, plagioclase: An86-100Ab14-0 [2]. Chromite, ilmenite and silica are also present in HaH 286 eucrite (Figs. 1,2, and [2]). According to EMP data HaH 286 contains: pyroxene (54 vol%), plagioclase (44 vol%), silica (1 vol %), ilmenite (0.8 vol %), chromite (0.1 vol %), and troilite (0.1 vol%) [2].

Figures 3,4, and 5 present Raman spectra from various parts of HaH 286 meteorite. Different minerals have been identified in the HaH 286 meteorite: clinopyroxene (Fig. 3), plagioclase (Fig. 4), quartz (Fig. 5), orthopyroxene, and brookite. Augite with composition En35Fs43Wo22 is revealed in Figure 3.

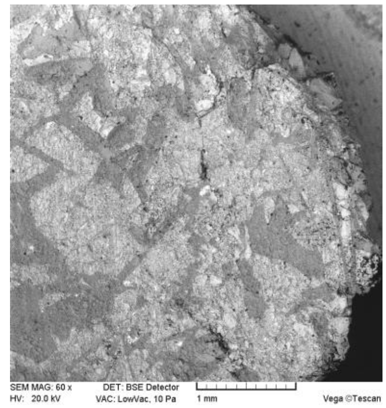

Fig. 1. BSE image of HaH 286 meteorite. Pyroxene crystals are light grey and medium grey, plagioclase dark grey, silica black, and ilmenite and chromite are white.

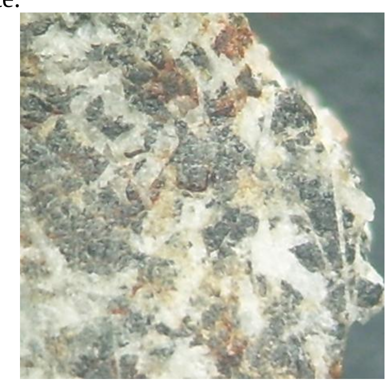

Fig.2. Optical image of HaH 286. The same area of the meteorite is shown. Pyroxene crystals are dark green, plagioclase white, ilmenite and chromite black.

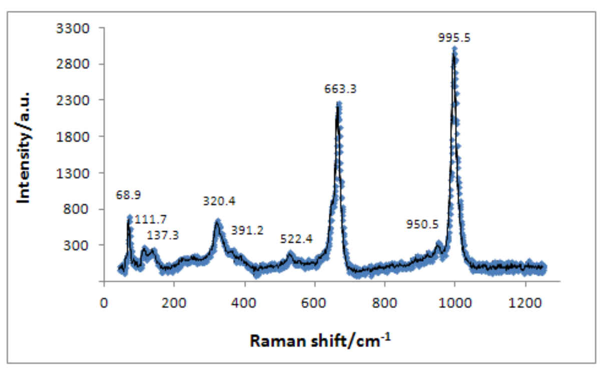

Fig. 3. Raman spectrum revealing augite. Peaks at 320.4, and 663.3 cm^{-1} indicate Mg/(Mg+Fe+Ca) = 0.35 (=En content), Ca/(Mg+Fe+Ca) = 0.22 (=Wo content) and composition En35Fs43Wo22.

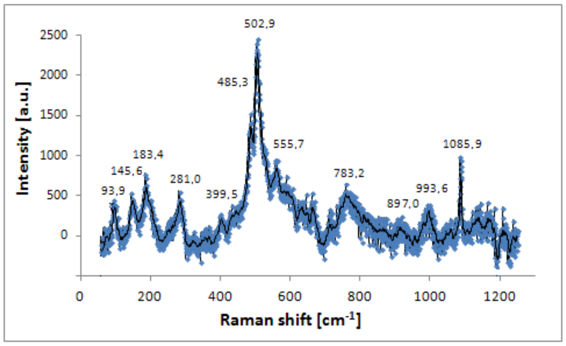

Fig. 4. Raman spectrum revealing plagioclase. Peaks at 485 cm^{-1} and 503 cm^{-1} indicate anorthite.

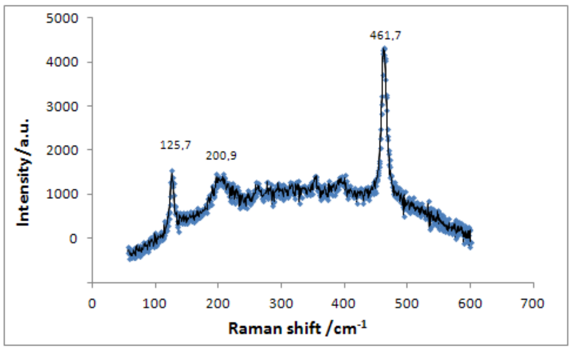

Fig. 5. Raman spectrum revealing quartz.

Figure 6 shows that the range of Mg/(Mg+Fe+Ca) values (values of enstatite content) in HaH 286 pyroxenes is between 0.27 and 0.42. The Raman data indicate that two clinopyroxenes are present in HaH 286: pigeonite and augite (Fig. 3).

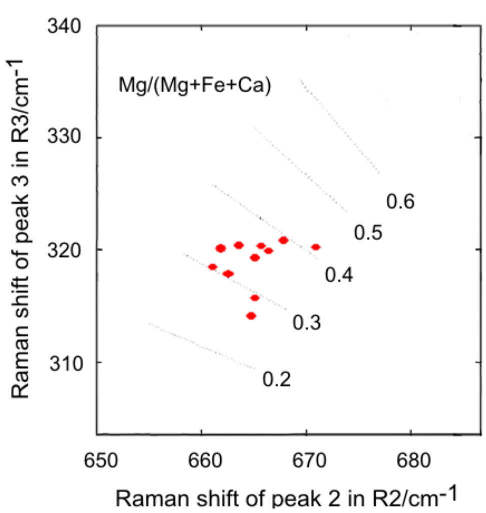

Fig. 7. Position of Raman peak 3 realative to position of Raman peak 2 for HaH 286 pyroxenes. Dashed lines mark values of Mg/(Mg+Fe+Ca) molar ratio (=En content), established by Wang and coworkers for basaltic pyroxenes [4].

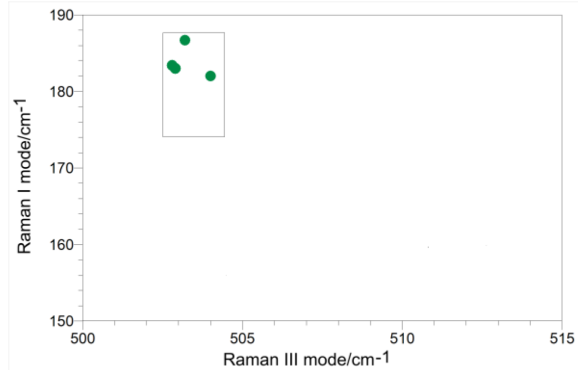

Fig. 7. Correlation of Raman I mode to Raman III mode for HaH 286 feldspars. It is seen that the two characteristic Raman peaks indicate anorthite region. The rectangle shows the anorthite range established for feldspars by Wang and coworkers [5] and Freeman and coworkers [6].

Silica is represented by quartz (Fig. 5) and titanium dioxide by brookite. Raman data indicate that enstatite content (En27-42, Fig. 6) in pyroxenes is in the wider range than it was previously reported (En34-36) [2]. The presence of augite (En35Fs43Wo22, Fig. 3), apart from pigeonite (range Wo5-13, mean En34Fs59Wo7 [2]) has been revealed.

Raman spectra features (multiplicity of peak groups, peak positions, peak widths) give the possibility to distinguish members within the feldspar group [5,6]. An analysis of the 180 cm^{-1} and 500 cm^{-1} Raman peaks positions indicates that HaH 286 plagioclase feldspar must be anorthite (Fig. 7). The agreement between the Raman data and EMP data for anorthite content in HaH 286 plagioclase (range An86-100, mean An88Ab12 [2]) is satisfactory.

Conclusion: The main and accessory eucrite minerals have been identified in the HaH 286 meteorite by micro-Raman spectroscopy. Most of them are the same minerals that we identified by analytical electron microscopy but En and Wo content in pyroxenes is higher than that previously reported [2].

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References: [1] Grossman J. N. and Zipfel J. (2001) *Meteoritics & Planet. Sci., 36,* A293-A322. [2] Szurgot M. and Polański K. (2011) *Meteorites, 1,* 29-38. [3] Huang E. et al. (2000) *Amer. Mineral. 85,* 473-479. [4] Wang A. et al. (2001) *Amer. Mineral. 86,* 790-806. [5] Wang A. et al. (2003) *LPS XXXIV,* Abstract #1676. [6] Freeman J.J. et al. (2008) *Can. Mineral. 46,* 1477-1500.