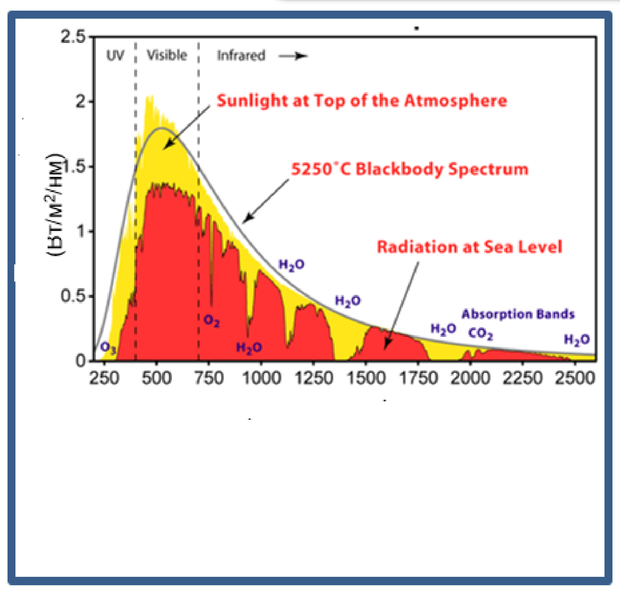
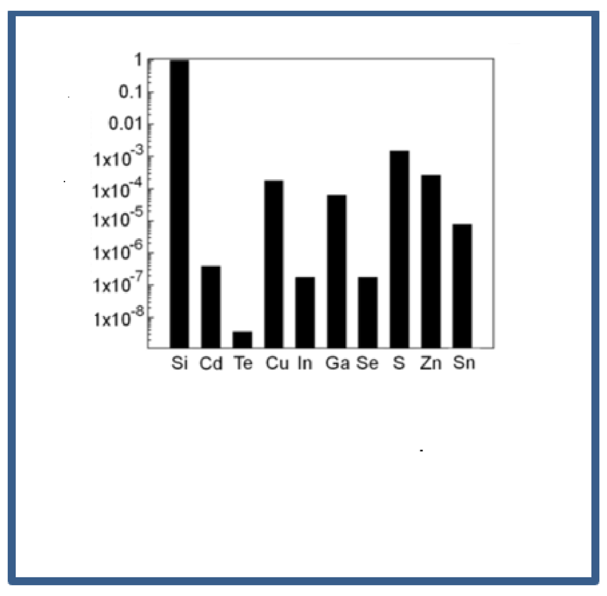
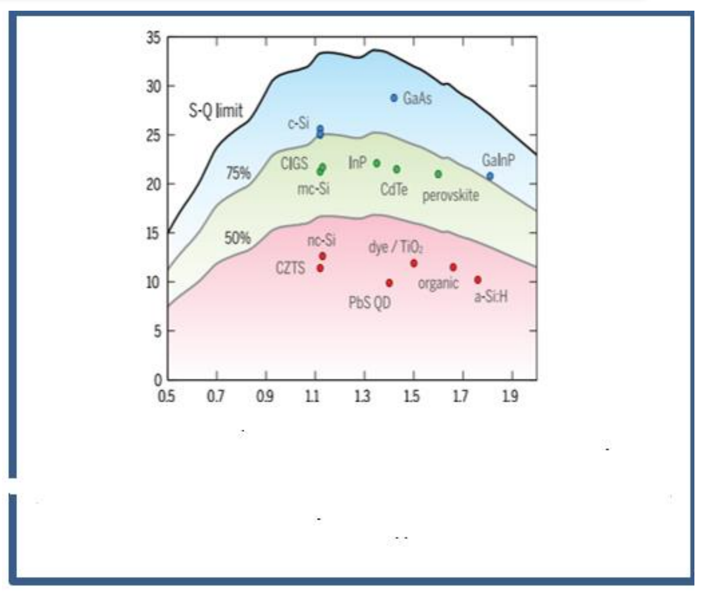
Raman investigations of $Cu_2ZnSn(S_xSe_{1-x})_4$ nanocrystals with different chemical composition

S. Kakherskyi, R. Pshenychnyi, O. Dobrozhan, A. Shamardin, A. Opanasyuk
Department of Electronics and Computer Technology,
Sumy State University. Rimsky-Korsakov str., 2, Sumy, UA-40007, Ukraine.
E-mail: s.kacherski@ekt.sumdu.edu.ua

Advantages of using $Cu_2ZnSn(S_xSe_{1-x})_4$ compounds as absorbers







- width bandgap (E_g = 1.0 eV) which is close to the optimal energy conversion of sunlight;
- high light absorption coefficient;
- p-type conductivity;
- long lifetime and high mobility of charge carriers;
- do not contain rare and environmentally hazardous components;
- widespread in the Earth's crust;
- the production cost is low.

Investigation of the nanocrystal properties

The study of Raman spectra was performed using a RENISHAW inVia Reflex microspectrometer and a solid-state laser with a wavelength of 785 nm as excitation sources. Features of the RENISHAW inVia Reflex microspectrometer: solid-state lasers with wavelengths of 532 nm and 785 nm and a maximum output power of at least 50 mW; diffraction gratings for 1200, 1800 and 2400 lines; confocal optical microscope equipped with 5x, 10x, 20x, 50x, 100x lenses.

Results

Fig. 1 shows Raman spectra from nanocrystals with different chemical compositions. The presence of the prominent peak of CZTS - 332 cm^{-1} confirms nanocrystals synthesis with the required chemical composition and single-phase structure to create nanoinks.

At the same time, particles with a high content of selenium were still two-phase composition.

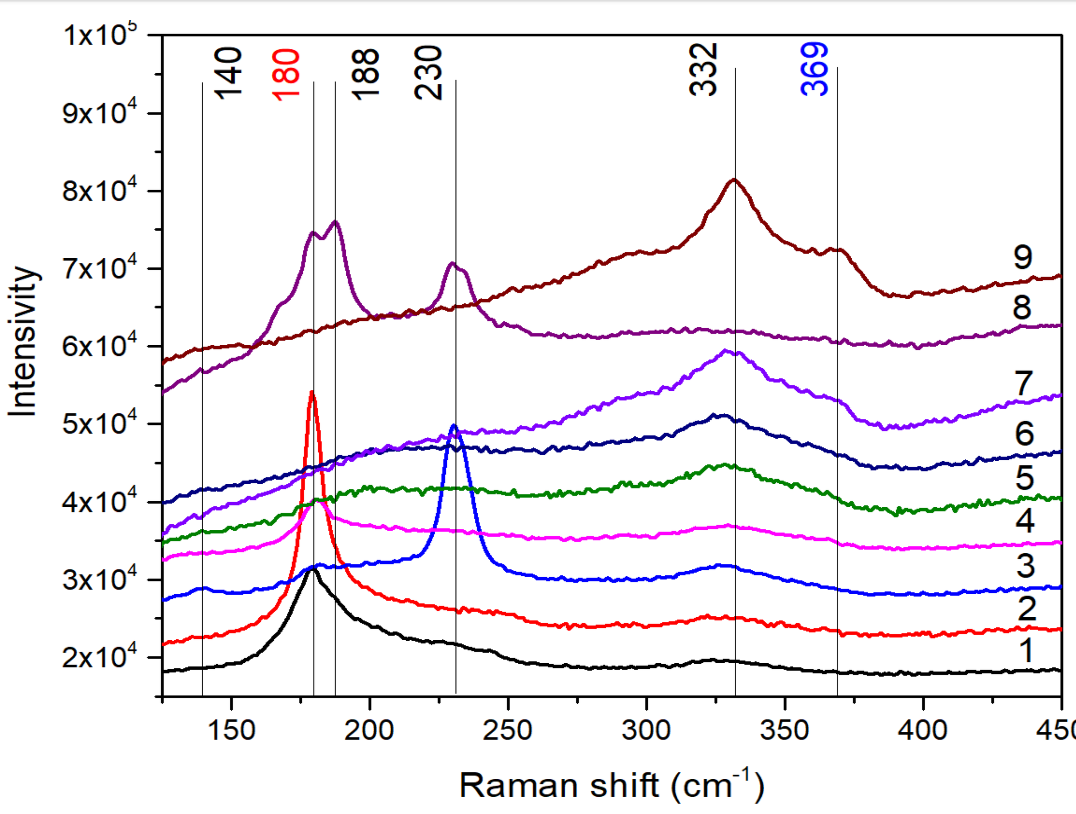


Fig 1. Raman Spectra of CZTSSe nanocrystals with different chemical composition: x = 1- 0; 2- 0,1; 3- 0,25; 4- 0,4; 5- 0,5; 6- 0,6; 7- 0,75; 8- 0,9; 9-1

Conclusions

- Raman investigations confirms nanocrystal synthesis with the required chemical composition and single-phase structure to create nanoinks
- Crystals with a high content of selenium were still two-phase;
- NCs of all studied compositions had a kesterite structure