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Laser induced metastable phases in microcrystalline silicon

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Experimental details

Si_{Met} plates used for microelectronics crushed in ball mill VEB Narva Vibrator DDR-GM 9458 for 2-10 min. Weighed portion Si_{Met} was ~ 100 mg in standard stainless steel mortar with two 10 mm WC balls.

Raman spectra in 80-3500 cm^{-1} region were registered with using a Horiba JobinYvon Larbram 300 spectrometer equipped Olympus BX2 microscope (Olympus M-Plan 50x and 100x lens), cooled CCD detector and excitation 632.8 nm He-Ne laser with power on sample up to 3 mW. The ~500 spectra were registered with laser beam focusing up to 1 μm circle. The heating of μ-Si particles from 25 to 300 ºC was performed using a Linkam heating stage. Conversion of power to radiation density is impractical due to non-plane surface of μ-Si particles.

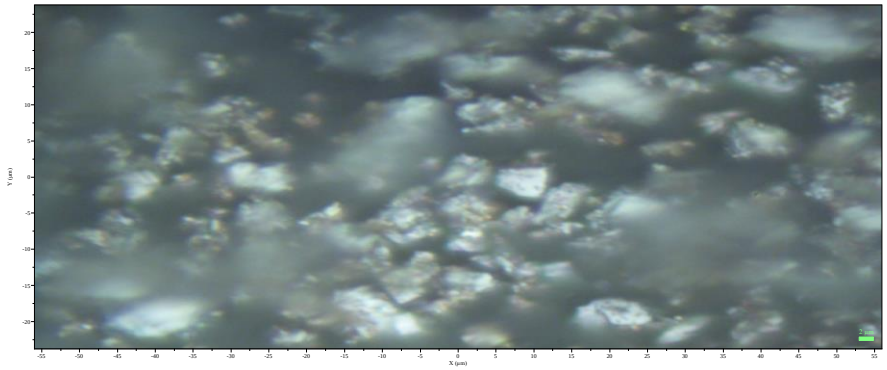

Figure S1. The photographs for Si microparticles.

Table S1. The parameters for the TO mode at different power

	Power increasing		Power decreasing	
Power, mW	Δν, cm^{-1}	FWHM, cm^{-1}	Δν, cm^{-1}	FWHM, cm^{-1}
0.03	520.4	4.4	520.5	4.4
0.3	519.3	5.1	519.1	5.0
0.75	517.5	5.7	517.5	5.6
1.5	512.2	8.4	512.3	8.2
3	501.7	17.2	501.7	17.2

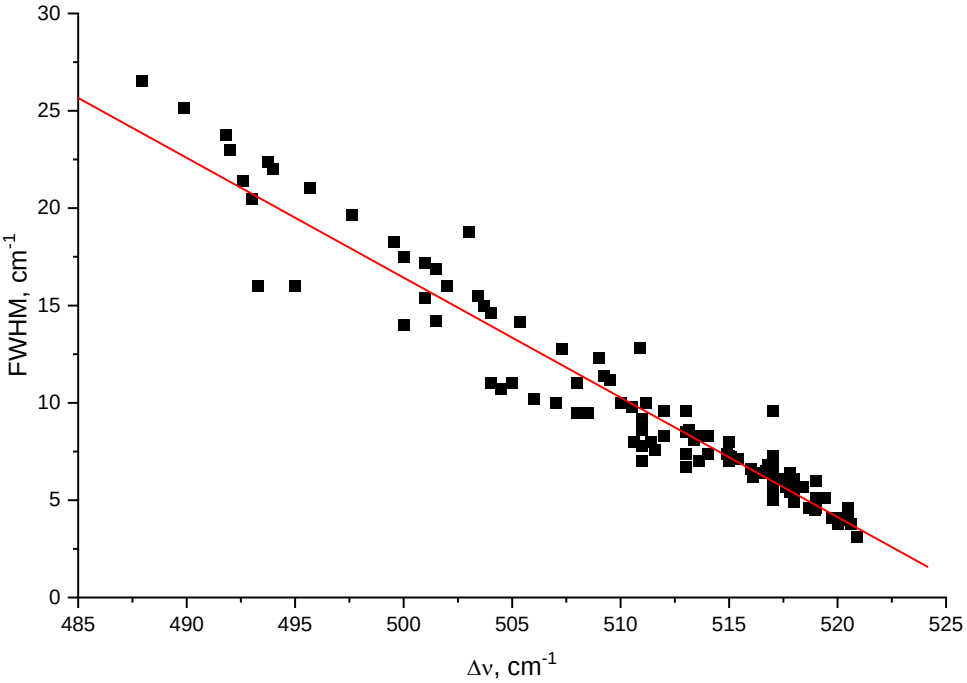

Figure S2. The position and FWHM correlation of the TO mode for microcrystalline Si_{Met} (μ-Si).

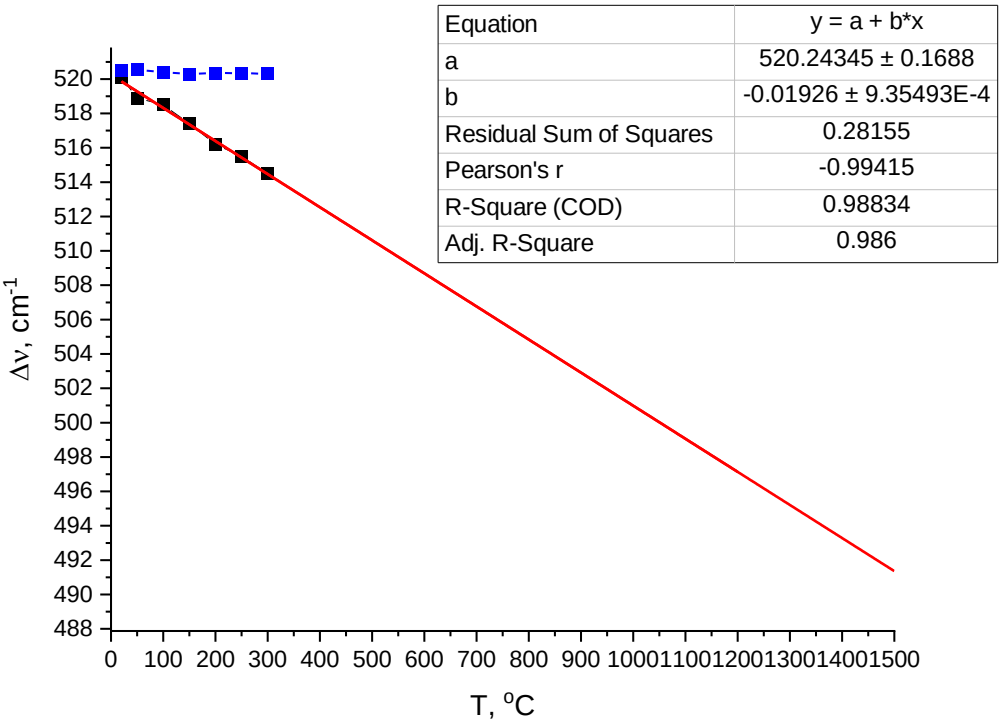

Figure S3. Temperature dependence and approximation of the TO mode position for microcrystalline Si_{Met} (red) in comparison to that for Si plate (blue).

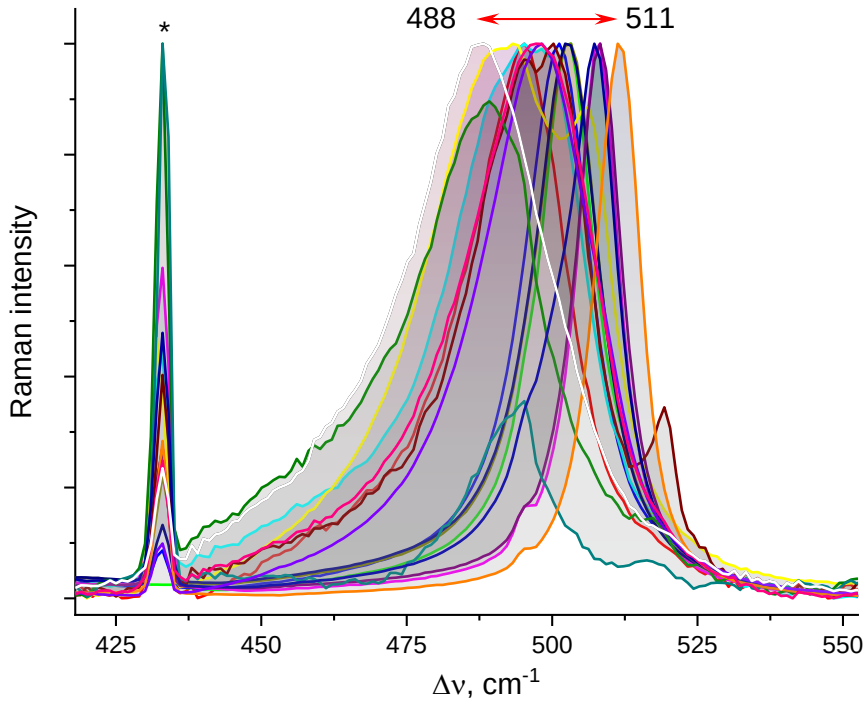

Figure S4. The TO mode position at 3 mW laser excitation power for different size Si particles (2 – 35 μm). * – the plasma line.

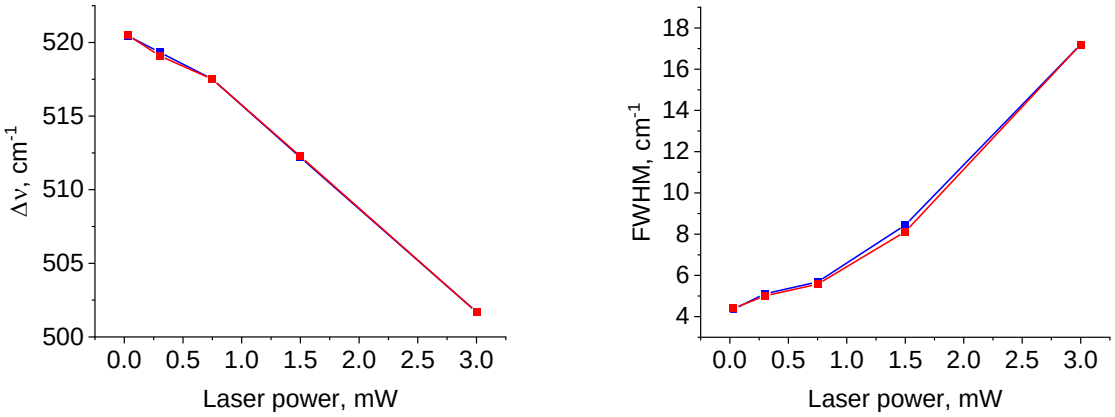

Figure S5. The dependence of the TO mode position (left) and its FWHM (right) during increasing (red) and decreasing (blue) laser power.

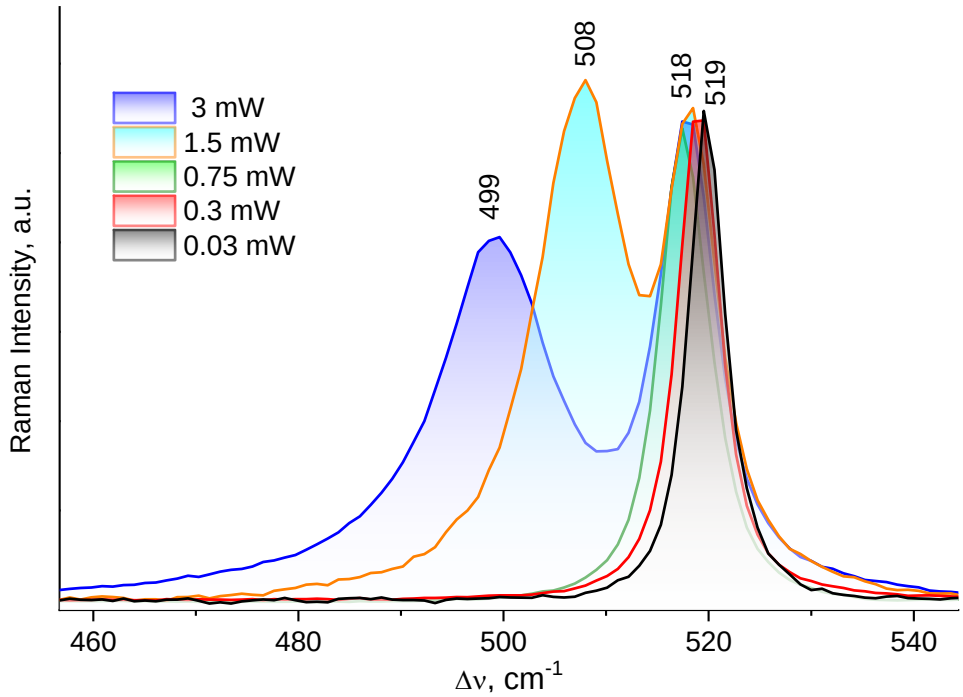

Figure S6. The splitting of TO mode corresponding to metastable phases.

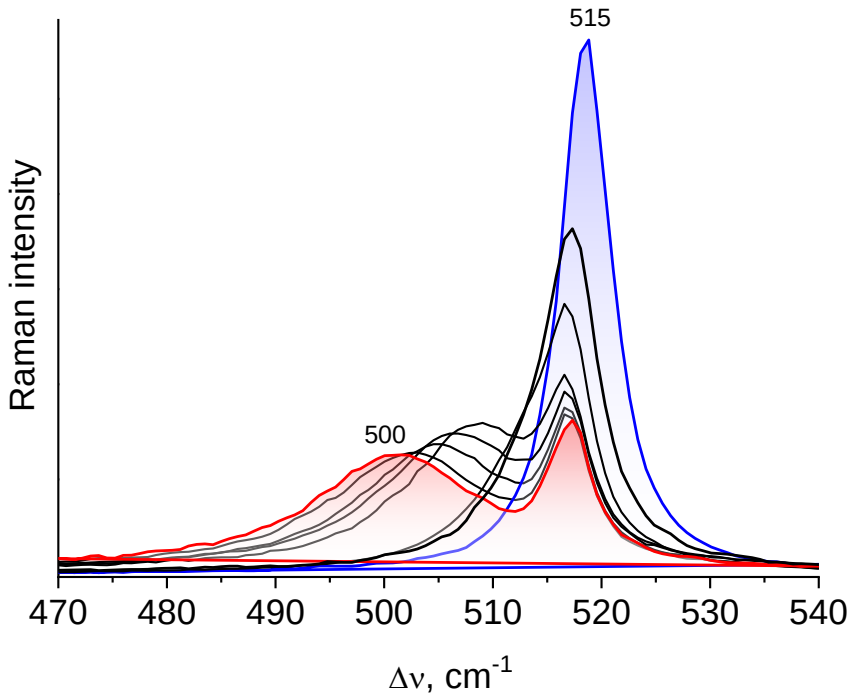

Figure S7. The series of Raman spectra for the fast annealing process (during 6 hours) of metastable phase in μ-Si. Red line is initial spectrum, blue line is final.

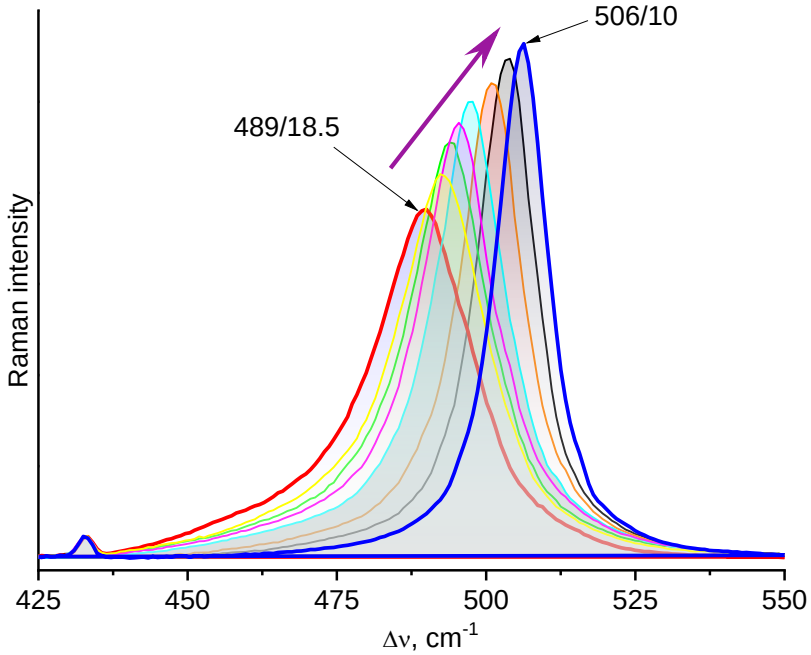

Figure S8. The series of Raman spectra for the annealing process of metastable phase in μ-Si during 2 days. Red line is initial spectrum, blue is final.

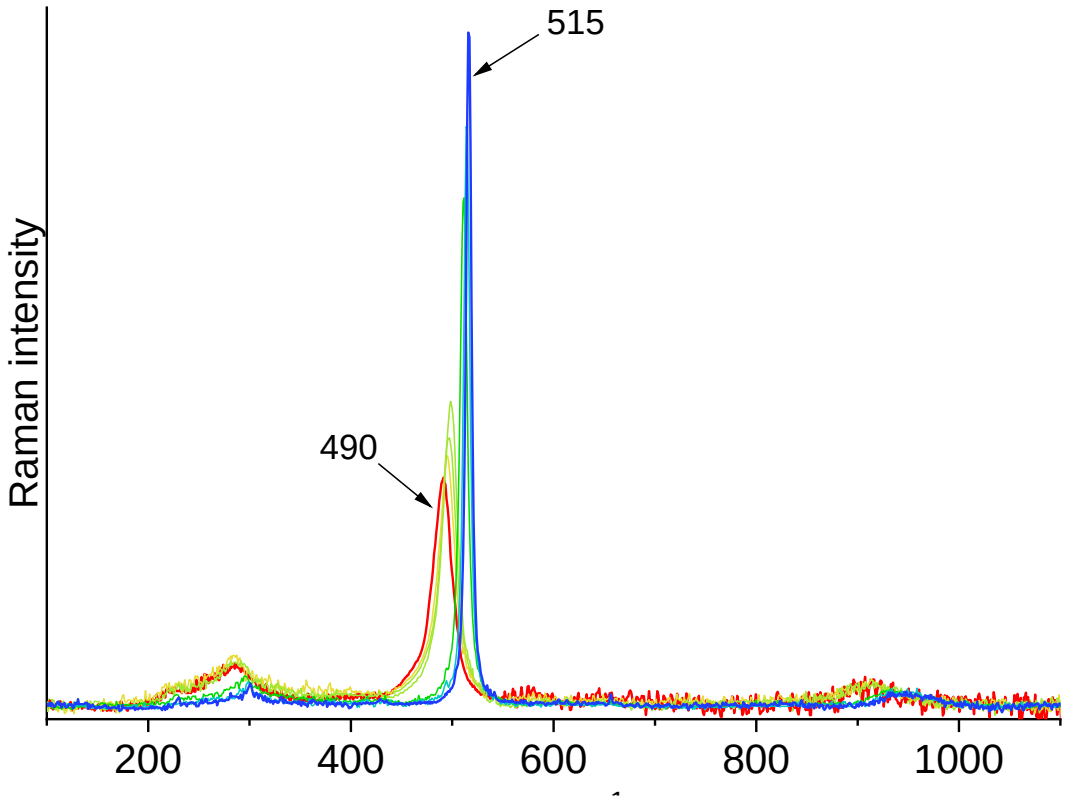

Figure S9. The series of Raman spectra (full range) for the annealing process of metastable phase in μ-Si during 4 days. Red line is initial spectrum, blue is final. Baseline is corrected.

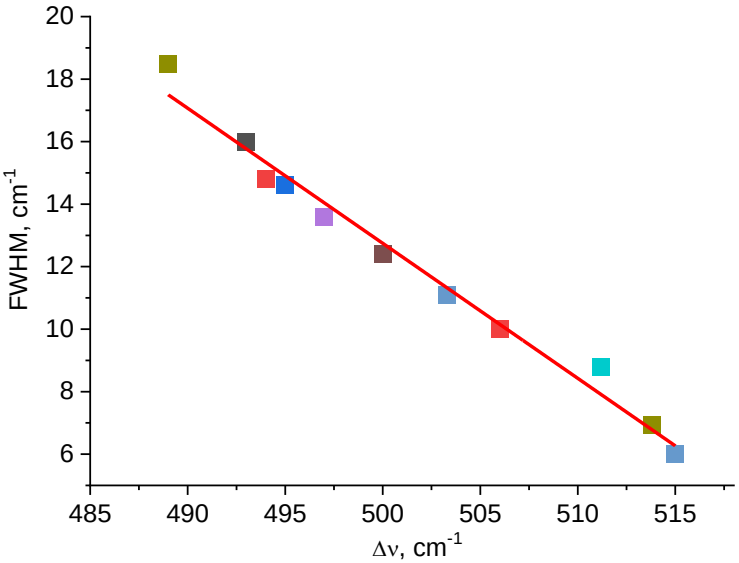

Figure S10. The correlation of the position and FWHM values obtained from Fig. S9.