

# Non-linear optical properties of nanostructured titanium nitride under high-power laser pumping in the fundamental absorption band

A.Sh. Gubanov<sup>1</sup>, S.S. Volchkov<sup>1</sup>, L.A. Kochkurov<sup>1</sup>, D.A. Zimnyakov<sup>1,2</sup>

<sup>1</sup>Yury Gagarin State Technical University of Saratov, 77 Polytechnicheskaya st., Saratov, 410054, Russia

<sup>2</sup>Institute for Problems of Precision Mechanics and Control RAS, 24 Rabochaya st., Saratov, 410028, Russia

Non-linear optical properties of titanium nitride nanoparticles were examined using the modified z-scan technique with simultaneous acquisition of the Rayleigh scattering at the direct angle to the polarization plane of a probe laser beam. The real and imaginary parts of the effective dielectric function of nanoparticles, depending on the pump intensity, at a wavelength of 355 nm and a laser pulse energy of 5.8 mJ were reconstructed from the obtained experimental data and displayed using the Cole-Cole diagram technique.

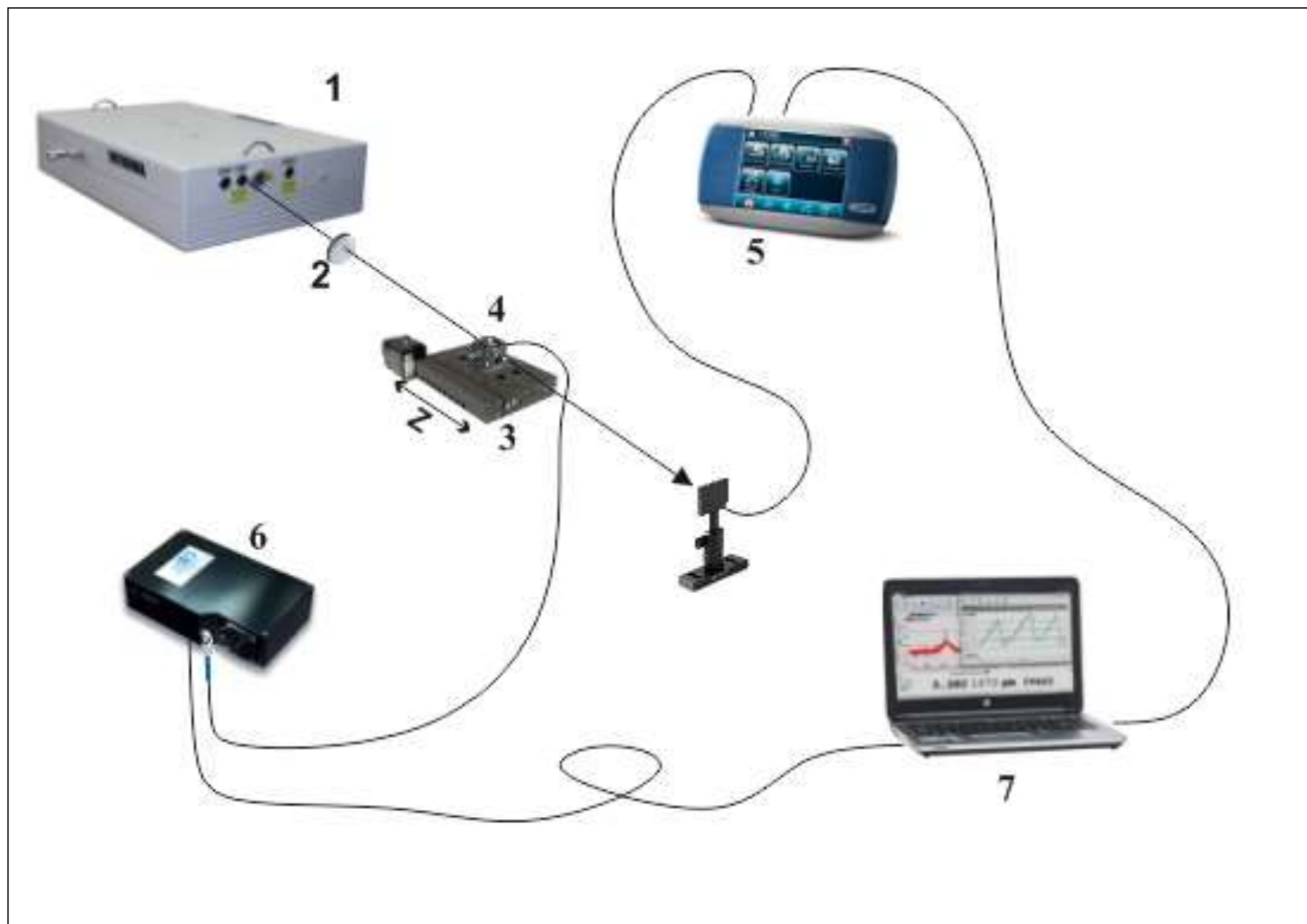


Fig. 1 – Scheme of the experimental setup. 1-laser LOTIS TII-2145-OPO; 2-lens,  $f = 150\text{mm}$ ; 3-positioner Standa 8mt167-100; 4-sample cuvette; 5-set of measuring equipment(energy sensor Gentec Q12MF1 + energy meter Gentec MAESTRO); 6- spectrometer Ocean Optics QE65000; 7-PC.

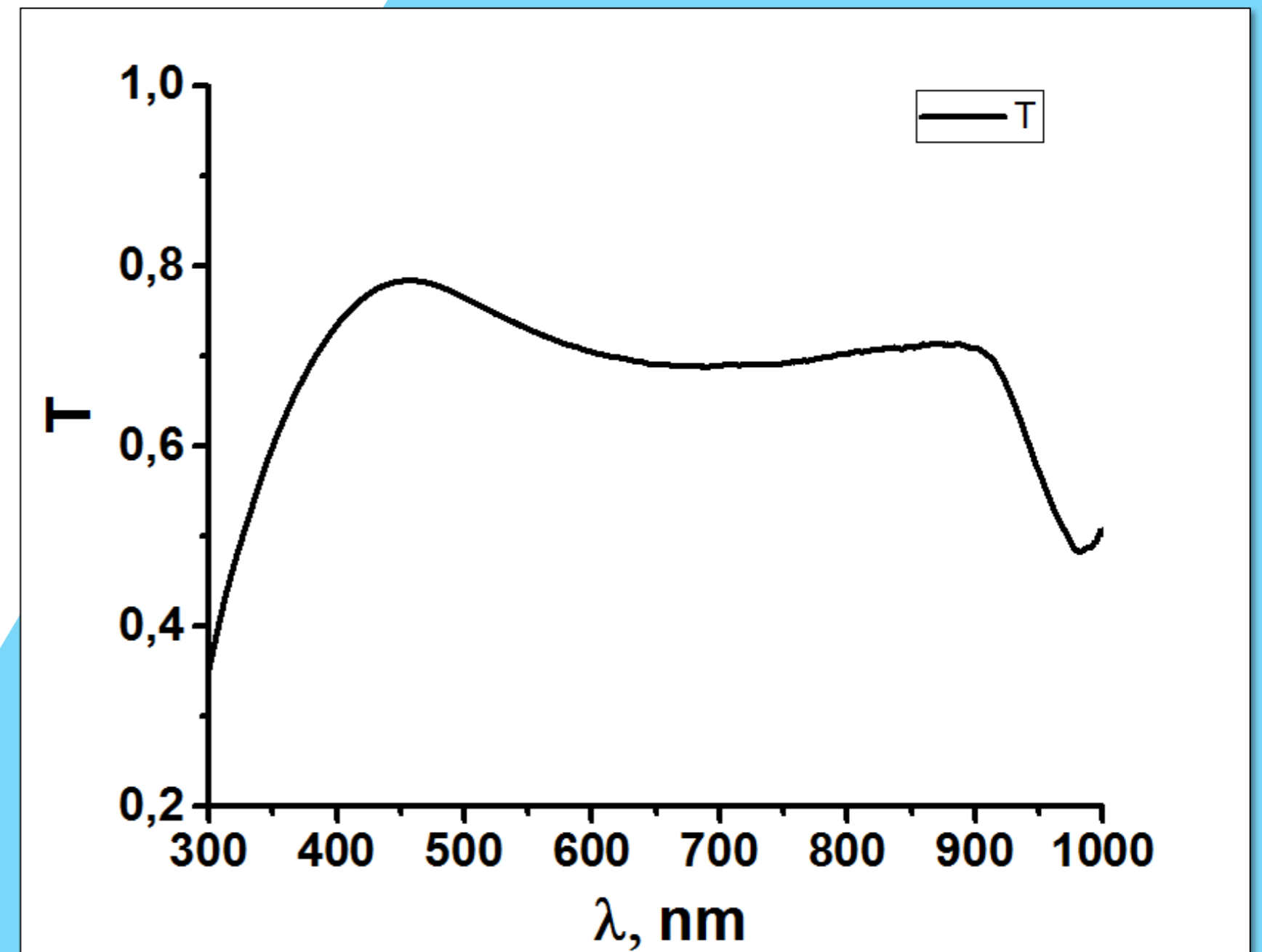


Fig. 2 –Collimated transmission spectrum of the TiN sample.

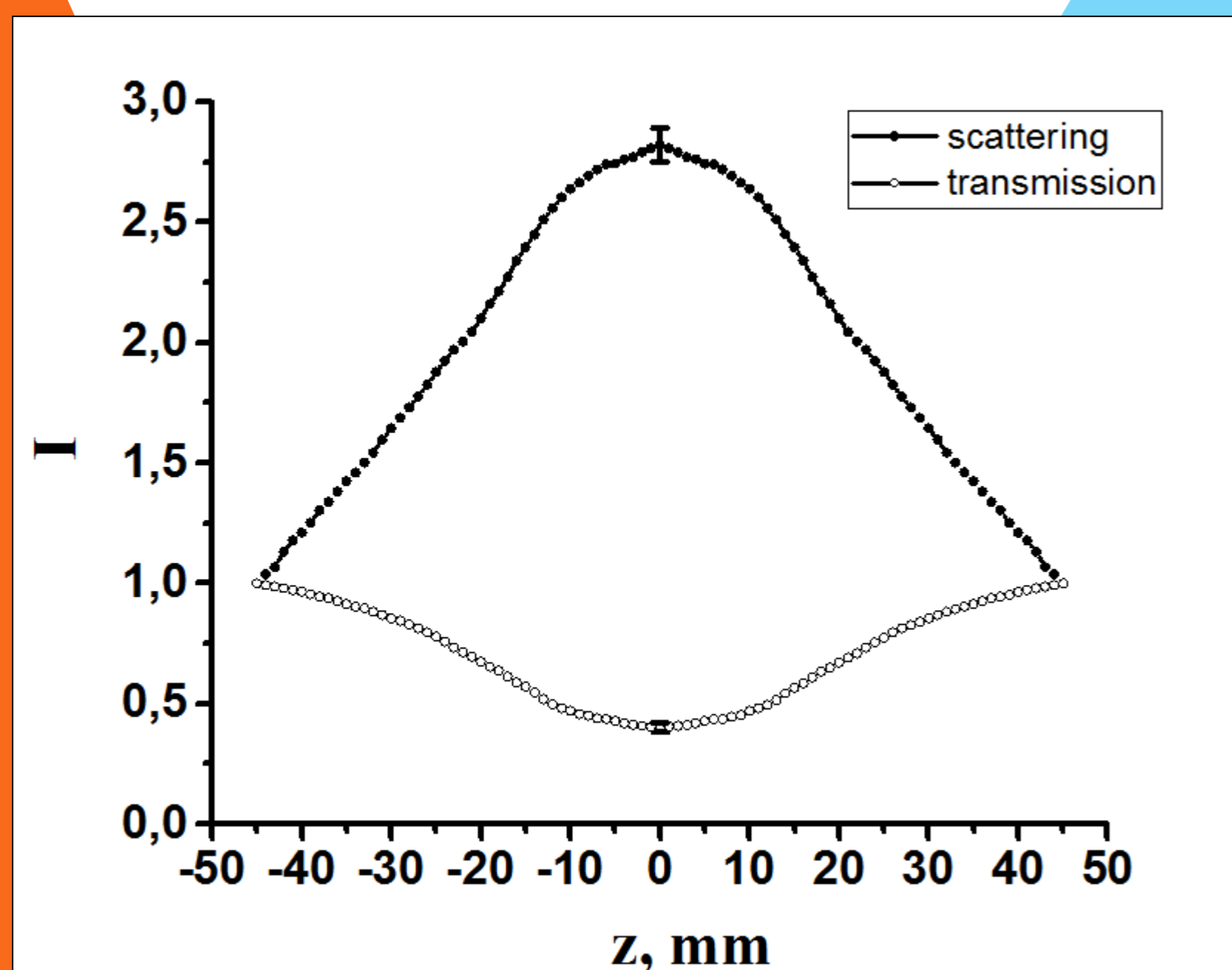


Fig. 3 — Normalized values of scattered (closed markers) and transmitted (open markers) intensity . Error bars correspond to the confidence level of 0.95.

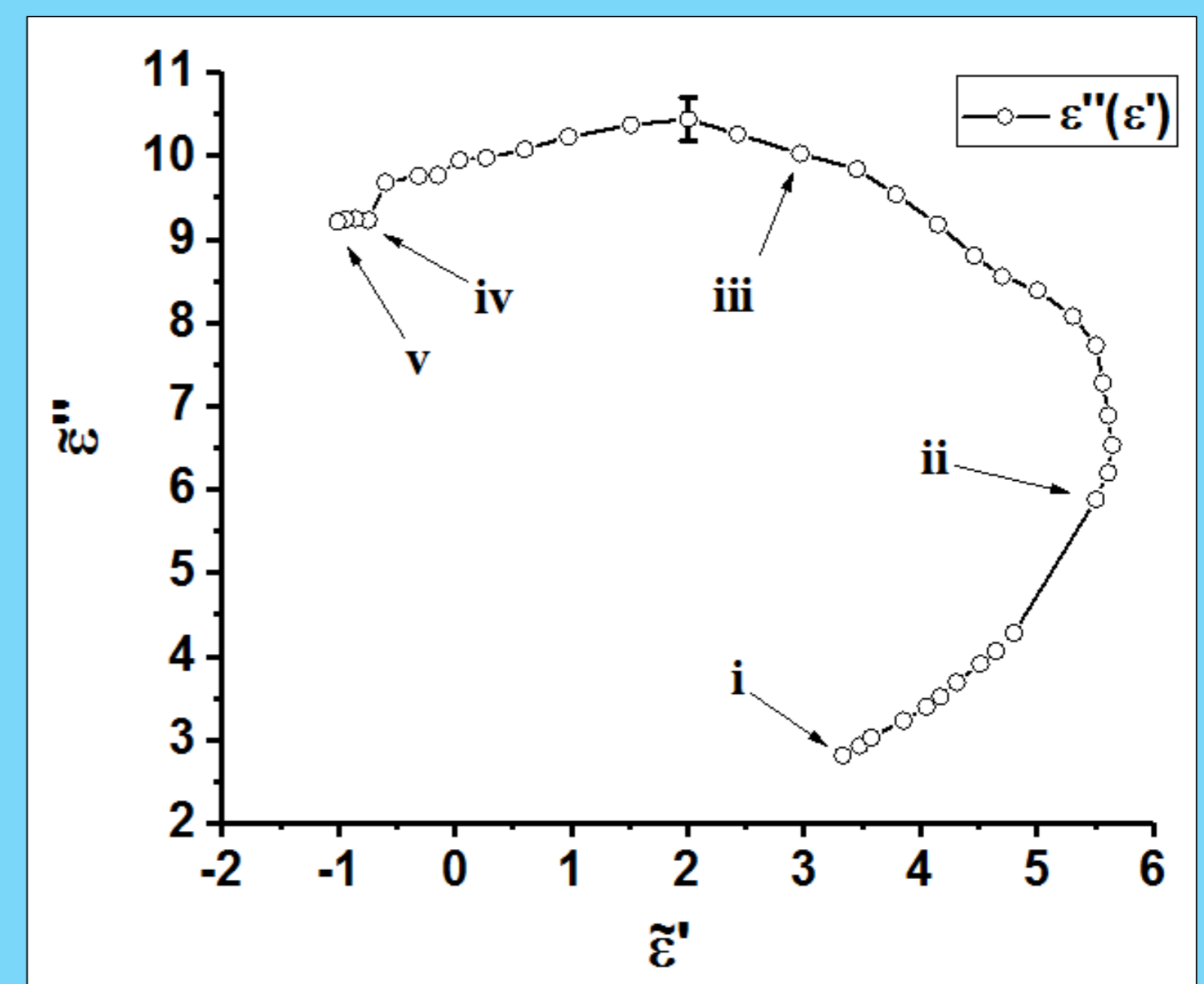


Fig. 4 — Cole-Cole diagram for the restored values of the real and imaginary parts of the effective complex dielectric function. Points i, ii, iii, iv, and v correspond to power densities  $i=2.31 \cdot 10^6 \text{W/cm}^2$ ;  $ii=9.67 \cdot 10^6 \text{W/cm}^2$ ;  $iii=2.4 \cdot 10^7 \text{W/cm}^2$ ;  $iv=1.17 \cdot 10^9 \text{W/cm}^2$ ;  $v=5.7 \cdot 10^{11} \text{W/cm}^2$ . Error bar corresponds to the confidence level of 0.9.

## ACKNOWLEDGMENT

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## Conclusions

TiN nanoparticles are characterized by relatively low variations of  $\epsilon'$  and  $\epsilon''$  when pumped inside the fundamental absorption band ( $\sim 340\text{nm}$ ). The Cole-Cole diagrams demonstrate the absence of manifestations of plasmonic properties in the UV range, which is explained by the inconsistency with the Frohlich resonance conditions for spherical particles.