Opto-Electronics Review, 2016, volume 24, issue 3, pp. 108-116

# Optical diagnostics of a single evaporating droplet using fast parallel computing on graphics processing units

*Jakubczyk, D.; Migacz, S.; Derkachov, G.; Woźniak, M.; Archer, J.; Kolwas, K.*

DOI: https://doi.org/10.1515/oere-2016-0019

Abstract:

We report on the first application of the graphics processing units (GPUs) accelerated computing technology to improve performance of numerical methods used for the optical characterization of evaporating microdroplets. Single microdroplets of various liquids with different volatility and molecular weight (glycerine, glycols, water, etc.), as well as mixtures of liquids and diverse suspensions evaporate inside the electrodynamic trap under the chosen temperature and composition of atmosphere. The series of scattering patterns recorded from the evaporating microdroplets are processed by fitting complete Mie theory predictions with gradientless lookup table method. We showed that computations on GPUs can be effectively applied to inverse scattering problems. In particular, our technique accelerated calculations of the Mie scattering theory on a single-core processor in a Matlab environment over 800 times and almost 100 times comparing to the corresponding code in C language. Additionally, we overcame problems of the time-consuming data post-processing when some of the parameters (particularly the refractive index) of an investigated liquid are uncertain. Our program allows us to track the parameters characterizing the evaporating droplet nearly simultaneously with the progress of evaporation.