Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 1523-1536, 2007
www.atmos-chem-phys.net/7/1523/2007/

Optical properties of absorbing and non-absorbing aerosols retrieved by cavity ring down (CRD) spectroscopy

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Abstract. Application of cavity ring down (CRD) spectrometry for measuring the optical properties of pure and mixed laboratory-generated aerosols is presented. The extinction coefficient (α_{ext}), extinction cross section (σ_{ext}) and extinction efficiency (Q_{ext}) were measured for polystyrene spheres (PSS), ammonium sulphate ($(NH_4)_2(SO_4)$), sodium chloride (NaCl), glutaric acid (GA), and Rhodamine-590 aerosols. The refractive indices of the different aerosols were retrieved by comparing the measured extinction efficiency of each aerosol type to the extinction predicted by Mie theory. Aerosols composed of sodium chloride and glutaric acid in different mixing ratios were used as model for mixed aerosols of two non-absorbing materials, and their extinction and complex refractive index were derived. Aerosols composed of Rhodamine-590 and ammonium sulphate in different mixing ratios were used as model for mixing of absorbing and non-absorbing species, and their optical properties were derived. The refractive indices of the mixed aerosols were also calculated by various optical mixing rules. We found that for non-absorbing mixtures, the linear rule, Maxwell-Garnett rule, and extended effective medium approximation (EEMA), give comparable results, with the linear mixing rule giving a slightly better fit than the others. Overall, calculations for the mixed aerosols are not as good as for single component aerosols. For absorbing mixtures, the differences between the refractive indices calculated using the mixing rules and those retrieved by CRD are generally higher.

Final Revised Paper (PDF, 1308 KB) Discussion Paper (ACPD)

Citation: Abo Riziq, A., Erlick, C., Dinar, E., and Rudich, Y.: Optical properties of absorbing and non-absorbing aerosols retrieved by cavity ring down (CRD) spectroscopy, Atmos. Chem. Phys., 7, 1523-1536, 2007. Bibtex EndNote Reference Manager