Correlation-induced double-plasmon excitations in simple metals studied by inelastic x-ray scattering

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The plasmon is a unique and well understood collective excitation in the interacting electron gas. More than three decades ago the simultaneous excitation of two plasmons was predicted as a special correlation effect [1]. However, a quantitative theoretical treatment of double-plasmon excitations was given only recently by many-body perturbation theory of the homogeneous electron gas beyond the random-phase approximation [2]. The calculations show that this correlation effect causes peak-like structures in the high energy-loss tail of the dynamic structure factor of simple metals. Indeed, such structures were experimentally observed in the dynamic structure factor of Aluminium and Sodium [3]. They can be attributed to intrinsic double-plasmon excitations based on a comparison with the calculations, because of the distinct momentum transfer dependence of their energy position and intensity. A systematic inelastic x-ray scattering study of intrinsic double-plasmon excitations for different materials as a function of electron density was accomplished very recently at beamline ID16 of the European Synchrotron Radiation Facility. The measured spectra of intrinsic plasmon-plasmon excitations of Lithium, Sodium, Potassium, Beryllium, Magnesium and Aluminium will be discussed and compared.

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