

Appearance of Plasmons in Fullerenes

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Appearance of Plasmons in Fullerenes

Sanja Korica^{*1}, Axel Reinköster^{*}, Markus Braune^{*}, Jens Viefhaus^{*}, Daniel Rolles^{*},
Giovanna Fronzoni[†], Daniele Toffoli[†], Mauro Stener[†], Piero Decleva[†], Omar M.
Al-Dossary[‡], Burkhard Langer^{**}, and Uwe Becker^{*,‡2}

^{*}Fritz-Haber-Institut der Max-Planck Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany

[†]Dipartimento di Scienze Chimiche, Università di Trieste, Via L. Giorgieri 1, I-34127 Trieste, Italy

[‡]Physics Department, College of Science, King Saud University, Riyadh, 11451, Saudi Arabia

^{**}Physikalische und Theoretische Chemie, Freie Universität Berlin, Takustraße 3, 14195 Berlin, Germany

Synopsis The valence electrons of fullerenes may be regarded as spherical distributions with a finite width of a jellium-like potential giving rise to collective motions of this orange peel electron cloud. They cause strong enhancement of the photoionization cross section, a resonant behavior phenomenon known as plasmon excitations. The number and characteristic features of these excitations will be discussed.

Since the discovery of the C₆₀ molecule in 1985 many studies have been performed to investigate its fundamental properties. These properties are mainly driven by its unique molecular structure like its spherical shell. One of the important characteristics of this molecule is the collective response of its valence electron cloud to electromagnetic radiation. This collective behavior gives rise to the occurrence of the giant dipole resonance a surface plasmon in the absorption spectrum centered around 20 eV, which has been analyzed theoretically by various authors. In addition, our photoionization cross-section measurements reveal a resonance near 40 eV, a volume plasmon analogous to observations made for C₆₀ ions which may be regarded as volume plasmon [1, 2, 3]. Time-dependent density functional calculations confirm the collective nature of this feature as corresponding plasmon excitation. A third excitation of this kind is predicted but not experimentally confirmed [4]. Concerning photoelectron emission, plasmonic excitations are char-

acterized by a particular intensity behavior near threshold. They follow the threshold behavior law predicted for the first time by T. Derrah Thomas [5]. Our measurements of the C₆₀ plasmon excitations above the C 1s ionization threshold confirm this law very well and are in unexpectedly good agreement with the corresponding behavior of K-shell satellite excitations in atoms such as neon [6].

References

- [1] S.W. Scully *et al* 2005 *Phys. Rev. Lett.* **94** 065503.
- [2] A.V. Korol and A. Solov'yov, 2007 *Phys. Rev. Lett.* **98** 179601.
- [3] S.W. Scully *et al* 2007 *Phys. Rev. Lett.* **98** 179602.
- [4] C. Xia *et al* 2009 *Phys. Rev. Lett.* **102** 156802.
- [5] T.D. Thomas 1984 *Phys. Rev. Lett.* **52** 417.
- [6] U. Becker *et al* 1986 *Phys. Rev. Lett.* **56** 1120.

¹E-mail: korica@fhi-berlin.mpg.de

²E-mail: becker_u@fhi-berlin.mpg.de