

Foreword: Exotic Carbon Nanomatter at Frontiers of Physics and Chemistry

Forefront advancements in modeling and characterization of fundamental and newly designed Carbon based nanocomposites (graphenes, fullerenes, polymers, crystals and allotropic forms, aromatic systems, carbohydrates, PAHs, etc.) are nowadays envisaged in various research fields targeting the nano-formation, quantification, indexing and interpretation of physical and chemical exotic properties related with space-time structure-evolution, phase transitions, chemical reactivity, topology, structure-property relationships etc., and related structural and optical/spectroscopic features and interactions.

These challenges are addressed by the present edited book in an integrated manner, approaching Carbon nanomatter and its exotic features along three main directions:

- Carbon elemental forms, from simple compounds to fullerenes, graphenes and nanotubes
- Topological, geometrical and molecular analysis of Carbon nanomatter
- Bondonic chemistry

The first direction unfolds the so called generalist approach to Carbon extended structures: it offers the introduction to Carbon allotropes (diamond, graphite, fullerene, and hydrocarbon fragments as diamondoids and benzenoids) in Chap. 1; the graphenic patterning for C_n fullerenes generation from $n = 60$ to $n = 100$ in Chap. 2; the physical characterization of graphenes by interpreting the spectra associated to collective excitations, phonons and plasmons, in Chap. 3; detailed investigations on exohedral reactivity of endohedral metallofullerenes with the aid of Diels-Alder reactivity in Chap. 4; the epitaxial growth of silicon carbide nanowires (SiC-NWs) with related phenomenology and experimental fingerprints (X-ray photoelectron spectroscopy, electronic microscopy) in Chap. 5; the ending section of the volume, Chap. 14, about van der Waals interactions in layered 2D structures of graphene (vs. those made of MoS_2) which are modifiable and tunable by external electric fields, completes this book by an outstanding communication on both theoretical and experimental perspectives of Carbon nanosystems.

The second direction focuses on the mathematical and computational characteristics of various Carbon nano-structures: reviewing the topological and group properties of Carbon armchair/zig-zag polyhex towards combined C_4C_8 nanotubes

and nanotori, in Chap. 6; the bridge graphs modeled by Zagreb indices accounting for chemical bonding in comb nanolattices, polymers, nanostars and dendrimers, spirochains and caterpillar trees or cycles are mathematically exposed (for future QSAR applications) in Chap. 7; recently invented D_5 allotropic diamantine structures are analyzed by topological and energetical advanced methods predicting exotic possible intermediates in the synthesis of some hyper-graphenes, in Chap. 8; protein-protein/ligand interaction is modeled by surface pocket analysis driven by fractal dimension while computations exploit all available data bases to unveil chemical key properties of protein surfaces towards biological functionalization and activity; all these topics are discussed in Chap. 9, closing this second direction centered on the conceptual-computational aspects of *micro-to-macro* Carbon structures;

The third direction of the book, intended as a “small treatise of chemical bonding by bondons”, goes through the advanced bosonic-bondons picture, being the bondon the new quantum quasi-particles associated to the chemical bonding field, by various approaches and prospects: Chap. 10 introduces the bondon within the quantum relativistic Dirac framework that, combined to the sub-quantum Bohmian treatment of the quantum potential, predicts the bondonic mass, reformulating the bonding-antibonding chemical space of bonding as *the bondon-antibondon universe*, with deeper insights in entangled chemistry, and bondonic identification by teleportation of the chemical bonding on the graphenic lattices; Chap. 11 reloads the bondonic mass prediction within quantum non-relativistic Schrödinger “classical” approach, deriving further extensions and space-time-gravity bosonic-fermionic information to characterize the chemical bond as *the bosonization of the condensation of pairing fermions*, paralleling the structure-reactivity analysis of benchmarking Carbon systems to confirm the validity of the bondonic paradigm in chemical bonding. Chap. 12 complements previous chapter information – bondonic velocity, charge, life-time and bondonic mass general behaviors compared with electron characteristics – and introduces the specific chemical bonding with illustrative applications to a series of silanes for which chemical metallic behavior is prognosticated, confirming the “unit cell” approach for complex silicene simulation; on the way of discovering the *bondonic existence*, Chap. 14 deals with Raman-IR spectroscopic methodology applied on a relevant series of ionic liquids (IL), with inherent dipole moment and fluctuating anionic-cationic polarization affecting ground and excited IL states, showing intimate correlations between the chemical bonding by bondons and the recorded biological activity, posing new exiting issues for studies in the near future.

Edited volumes are somehow more demanding than authorship monographs. This because editors face several possible directions of the book which evolve as the single contributions come, prompting editors to rearrange the frame of the book in order to preserve volume uniform flow and identity. If we succeed in completing the present venture is just because we benefited by exquisite contributions of eminent Scientists from Europe, America, and Asia that gave their best to help the understanding of the Carbon phenomenology and Carbon nanomatter either existing or designed. We do thank them all for the consistent support they encompassed in contributing first-class scientific chapters providing the audience with broad perspectives on chemical exotic structures and frontier modeling in general and of those involving Carbon in particular!

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