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Superconductivity and unusual magnetic behavior in amorphous carbon

Traces of superconductivity (SC) at elevated temperatures (up to 65 K) were observed by magnetic measurements in three different homogeneous sulfur doped amorphous carbon (a-C) systems: (a) in commercial and (b) synthesized powders and (c) in a-C thin films. (a) Studies performed on commercial (a-C) powder which contains 0.21% of sulfur, revealed traces of non-percolated superconducting phases below $T_c=65$ K. The SC volume fraction is enhanced by the sulfur doping. (b) a-C powder obtained by pyrolytic decomposition of sucrose did not show any sign for SC above 5 K. This powder was mixed with sulfur and synthesized at 400°C (a-CS). The inhomogeneous products obtained, show traces of SC phases at $T_c=17$ and 42 K. (c) Non-superconducting composite a-C-W thin films were grown by electron-beam induced deposition. SC emerged at $T_c=34.4$ K only after heat treatment with sulfur. Other parts of the pyrolytic a-CS powder, show unusual magnetic features. (i) Pronounced irreversible peaks around 55-75 K appear in the first zero-field-cooled (ZFC) sweep only. Their origin is not known. (ii) Unexpectedly these peaks are totally suppressed in the second ZFC runs measured a few minutes later. (iii) Around the peak position the field-cooled (FC) curves cross the ZFC plots ($ZFC > FC$). These peculiar magnetic observations also ascribed to a-CS powder prepared from the commercial a-C powder and are connected to each other. All SC and magnetic phenomena observed are intrinsic properties of the sulfur doped a-C materials. It is proposed that the a-CS systems behave similarly to well-known high TC curates and/or pnictides in which SC emerges from magnetic states.

Biography

Israel Felner has completed his PhD at the age of 32 years from the Hebrew University (HU) Jerusalem and postdoctoral studies from University of California San-Diego. He was the director of Physics studies in HU. He has published more than 470 papers in reputed journals and serves as an editorial board member of three journals.

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