Experimental proofs of collective electron states and their localization into porous composites from nanodiamond and pyrocarbon

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Abstract The results of experimental research of NDC composite from nanodiamond and pyrocarbon (graphene flakes) [1-6] shown that NDC has 3D skeleton with fractal dimension 1.95 ÷ 2.14. NDC is solid and bulk semiconductor with porous structure (fig.1a), its electrical conductivity, band structure, X-ray diffraction pattern, Raman, IR, Auger, XPS etc. properties depend from γ = mass ratio of sp^2/sp^3 phases. The calculation of collective electronic states in nanodiamond by DFT method [7] showed the existence of three distinct classes of states: collective bonding states; surface-localized non-bonding conductive Tamm states and subsurface-localized bonding states. The good agreement of experiments (fig.1.a-d) and theory [7] allows us to conclude that NDC is new family of magnetic semiconductors with the controlled band structure and T-spins transport are same to the one from topological insulators.

References

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Figures

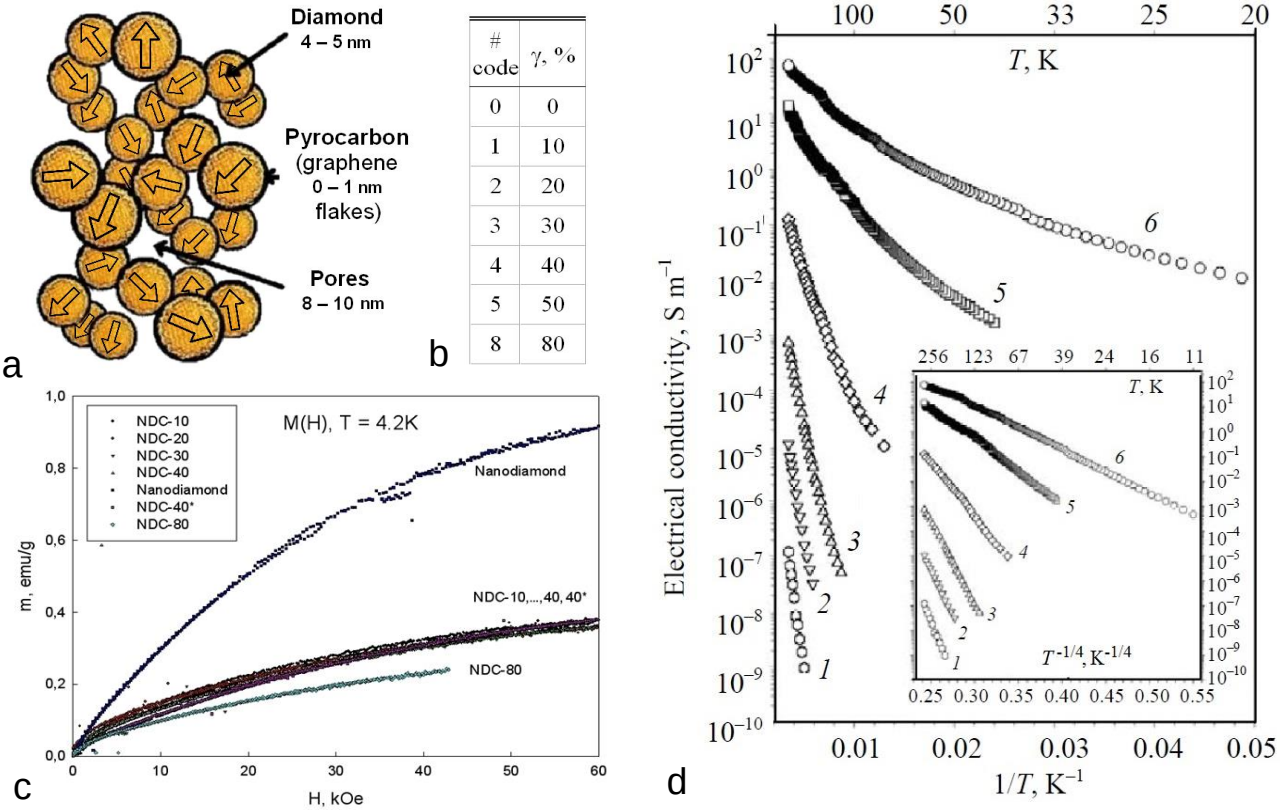

Fig.1. a) structure of NDC; b) coding of samples by ratio of sp^2/sp^3 phases; c) magnetic susceptibility; d) semiconducting properties from electrical conductivity (are confirmed by band gap from IR spectra).