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RZHANOV INSTITUTE OF SEMICONDUCTOR PHYSICS SB RAS

VOEVODSKY INSTITUTE OF CHEMICAL KINETICS AND COMBUSTION SB RAS

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NOVOSIBIRSK STATE UNIVERSITY

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N.N. Vorozhtsov Novosibirsk Institute of Organic Chemistry SB RAS

The Institute of Organic Chemistry , Siberian Branch of the Russian Academy of Sciences was founded in 1958. NIOCh SBRAS is the one of the world-recognized leaders in synthesis of organic molecules in particular nitroxide and trytil stable radicals which are widely used as spin probes and spin labels; complexes of organic compounds with metals, polymers and photoactive materials, fluorine compounds. Main research fields of the NIOCh SBRAS are the reactivity of chemical compounds, mechanisms of chemical reactions, application of magnetic resonance (NMR and EPR) to study physical-chemical properties of different compounds, applications, development of fundamentally new magnetic materials.

Rzhanov Institute of Semiconductor Physics

The Institute of Semiconductor Physics, Siberian Branch of the Russian Academy of Sciences (ISP SBRAS) was founded in 1964 based on the unification of the Institute of Solid Physics and Semiconductor Electronics SB USSR AS. Presently, the Institute is a research centre with a wide field of activities in modern semiconductor physics, physics of condensed state in the development of scientific bases for semiconductor micro-, opto-, nano- and acoustoelectrtonics, information technologies and quantum electronics

International Tomography Center SB RAS

The International Tomography Center of the Siberian Branch of the Russian Academy of the Sciences (ITC SB RAS) was founded in 1993. Since 2000, the International Tomography Center has been a research institute at the Novosibirsk Science Center of the Siberian Branch of the RAS. ITC SB RAS is the one of the world-recognized leaders in spin chemistry, carrying out basic and applied research in chemical physics and medicine. Main research fields of the Center are the chemical bonding theory, reactivity of chemical compounds, mechanisms of chemical reactions, magnetic phenomena in chemistry and medicine, spin and exchange phenomena, including multispin coordination compounds, diagnostic NMR-imaging and NMR-microimaging for physical-chemical applications, development of fundamentally new magnetic materials.

Voevodsky Institute of Chemical Kinetics and Combustion SB RAS

Voevodsky Institute of Chemical kinetics and Combustion SB RAS was founded in 1957. The main focus of the Institute is chemical radiospectroscopy, i.e. the application of magnetic resonance to structural chemistry and to kinetics with simultaneous development of theory and experiment for these purposes. Another modern research area is spin chemistry that was created mainly by investigations conducted in the Institute. Spin chemistry reveals the effects of magnetic field and spin state on the interaction between active intermediate particles in elementary chemical steps.

Novosibirsk State University

Due to its vast resources Siberia has always been and remains the essential region for all of Russia. Where there are resources, there will be industry, and where there is industry, there will always be a need for scientific personnel. Following this simple logic, Novosibirsk Akademgorodok was established in the heart of Siberia, and in a short while Novosibirsk State University became its most valuable and integral part.

In the late 50s Siberia provided the country with 75% of coal and possessed 80% of its hydropower resources. Siberia quickly became industrial, but science was largely the applied type which did not satisfy the needs. The USSR Academy of Sciences decided there was a need for fundamental science. To pursue fundamental science they needed a new type of professional. They needed a lot of potential employees that corresponded to this new profile. Thus, Novosibirsk State University was born.

Paramagnetic properties of atherosclerotic plaques and synthetic calcium phosphates to follow pathological calcification processes

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Atherosclerosis (AS) is a chronic progressive inflammatory process in arterial vessels, initiated by the damage of endothelial cells with the involvement of monocytes, macrophages and dendritic cells being under conditions of oxidative stress. AS is a cause of thrombosis of arteries, leading to acute cardiovascular complications. Generally, the thrombosis is usually preceded by a fibrous cap rupture of AS plaques (ASP) and, to a lesser extent, a superficial erosion of endothelium. Understanding the physical and chemical factors that are connected with the ASP calcification and stability is a matter of controversy and extensive investigations [1, 2].

We have studied plaque tissues of aorta walls from male patients with AS gathered postmortem or during carotid endarterectomy operations. The micromorphology and chemical content were defined by scanning electron microscopy (SEM, Merlin), electron dispersive spectrometer (EDS, AZtec), X-ray diffraction (XRD, D8-Advance). Pulsed EPR and ENDOR are done at 94 GHz, T = 6-300 K (Bruker E-680) for native and radiation-induced paramagnetic centres. The results are compared with those obtained for "pure" and cation-substituted synthetic calcium phosphates – hydroxyapatite (HA), tricalcium phosphate (TCP), octacalcium phosphate (OCP).

From the SEM/EDS/XRD the presence of only HA in the calcified (Ca/P > 1.0) and other CaP (probably TCP and OCP) in samples with Ca/P < 0.6 was found. By XRD in some samples nanosized HA deposits (< 50 nm) were detected. Mn^{2+} and radiation-induced CO_2^- radicals were detected and identified by EPR. Their EPR spectral and relaxation characteristics depends on the calcification degree, location (cap, shoulders or core of ASP), ASP stability. Correlation ($p < 0.05$) between the relaxation characteristics of Mn^{2+} ions and ASP stability was found [3-5]. The results show that due to the small sample volume (500 nL, 0.5 mm cross section) and high spectral resolution pulsed high-field EPR can be used as a tool to study different parts of ASP to follow the presence of paramagnetic centers and calcification processes.

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