LOW TEMPERATURE PLASMA IN CONTACT WITH LIQUIDS: A TOOL FOR MODIFICATION AND SYNTHESIS OF NEW MATERIALS*

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The use of low-temperature plasma in various fields of industry, scientific research, and medicine has been known for a long time. Recently, a trend has emerged in the use of low-temperature plasma as a method for obtaining new materials or modifying processed ones in order to give them improved specified properties. Thus, low-pressure plasma is used to modify the surface of various materials (semiconductors, polymers). The synthesis of new structures, for example oxides from metals, can be carried out in both gas and liquid phases. Under conditions of low-temperature plasma of gas discharges, synthesis proceeds more successfully in water vapor or in aqueous solutions.

Recent studies have shown that low-temperature gas discharge plasma can be used to treat sols to produce compounds with improved properties. An underwater diaphragm discharge excited from an alternating current source is used as a source of low-temperature plasma. When voltage is applied to the electrodes, an electrolysis current begins to flow and a vapor-gas bubble appears in the area of the small diaphragm hole. With a further increase in voltage, the bubble breaks down and a discharge is ignited inside it. Next, the bubble collapses with the appearance of shock and sound waves and the process repeats. Plasmolysis products enter the main volume. The action of the shock wave causes the electrode to sputter. It confirmed by data on the loss of electrode mass and the appearance of lines of metal atoms in the emission spectrum. The sprayed material can be incorporated into the structure of the processed material or oxidize and create structures of binary compounds.

This was demonstrated using the example of titanium dioxide (formation of doped TiO_2 structures with improved photocatalytic characteristics) [1,2] and molybdenum and tungsten oxides (formation of binary structures based on non-stoichiometric Mo and W oxides with enhanced photochromic properties) [3]. In the case of vanadium oxide sols (V_2O_5), the action of a diaphragm discharge leads to the formation of doped structures, as well as to the appearance of vanadium oxides in intermediate oxidation states (non-stoichiometric oxides) V_3O_7 and $V_{10}O_{24}$.

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