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Application of High-Voltage Nanosecond Pulses to Surface Modification of Geomaterials

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The application of High-Power Electromagnetic Pulses (HPEMP) in dressing of resistant gold- containing ores appears attractive as this technique provides for a significant increase in precious metal recovery in hydrometallurgical (gold and silver) and gravitational (PGM) processes (V.A.Chanturiya et al, Pulsed Power Conference, 2005 IEEE). The present work studies the effect of high-voltage nanosecond pulses on the phase composition of surface layers, physical-chemical and technological properties of sulfide minerals with different semiconductor properties and natural dielectric minerals using a complex of physical and chemical methods (XPS, DRIFTS, SEM-EDX, AFM), microhardness measurement (Vickers indentation method). High-voltage nanosecond pulses cause changes in the chemical and phase surface composition of sulfide minerals and their sorption, flotation, and chemical activities. The influence of the conditions and parameters of the electric-pulse effect on the change in the amount of elemental sulfur and iron (metal) oxide on the surface of mineral particles has been studied. The parameters of preliminary pulsed treatment of sulfide minerals (for example, pyrrhotite and pentlandite; pyrite and arsenopyrite) that lead to improvement of flotation separation of minerals have been determined. Pulse energy actions damage the surface microstructure of dielectric minerals with the subsequent formation of traces of surface breakdowns and microcracks, loosening rock-forming minerals, and reducing their microhardness by 40–66% overall. The softening effect of natural dielectric minerals is mainly connected with the damage of microstructure of surface layers, new-formed defects at different structural levels (dislocation, microcracks, and incomplete surface break-ups), disordering and amorphisation of the mineral surface. Our results show that it is possible in principle to use pulse energy actions to improve the efficiency of softening rock-forming minerals in diamond-bearing kimberlites and making targeted changes in the functional chemical (structural phase) state of natural dielectric and semiconductive minerals.

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