Chemiluminescence in the reactions of uranium and lanthanides

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We report on new peculiarities of chemiluminescence of 4f - (Pr, Nd, Eu, Tb, Dy) and 5f - elements (uranium) in aqueous and organic solutions as well as in solid phase:
1. Formation of excited states in the oxidation of threevalent lanthanide complexes by organic oxidant dimethyldioxirane occurs due to an energy released upon oxidation of the ligands.
2. Chemiluminescence of uranyl ion (UO$_2^{2+}$) is observed during the oxidation of U(IV) by the inorganic oxidants XeO$_3$, XeF$_2$, O$_3$, S$_2$O$_8$ etc. Electron transfer is responsible for UO$_2^{2+}$ excitation. Chemiluminescent method for analysis of extremely low concentrations (as low as $10^{-14}$ M) of uranium is suggested.
3. Lanthanides in ground and excited states catalyze decomposition of dioxetanes (DO). Formation of the complexes DO - lanthanide chelates precedes DO decomposition. Quantum chain reactions with energetic branching are realized during this catalytic process. Excited europium Eu(III) ions are formed in two excited states which take part in branching of the chain. It was shown that Eu(III) ion in excited state forms more stable complex with DO then that in ground state. In this connection, the problem of f-shell participation in chemical bonding is discussed.
4. Chemiluminescence occurring upon thermal solid phase decomposition of Eu persulfate and uranyl ions has been revealed.


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