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Life expectancy prediction of organic solid states based on chemiluminescence experiments and model-free simulation

Various organic materials react with environmental oxygen. They oxidise and therefore change their optical, mechanical and chemical properties. For the adequate conservation of solid materials used in art and cultural artifacts, substantial knowledge about the stability and the sensitivity to oxygen of organic materials is of particular importance.

Previous research has shown that established analytical methods such as oven-ageing tests and oxygen uptake techniques are very laborious. Furthermore, short-time experiments such as measuring the oxidation induction time OIT or -temperature OIT* using DSC or other conventional thermo-analytical methods are unsuitable for long-term prediction of oxidative behavior because of the use of elevated temperatures in the experimental conditions. Various studies indicate that measurement of oxidation-induced chemiluminescence can be a useful aternative to determine the stability of organic materials against oxidation.

The principle of chemiluminescence in the oxidative reactions studied is not yet entirely understood. It is believed to be a termination of two peroxy radicals in a Russel mechanism. The chemiluminescence emission results from the relaxation of excited triplet carbonyl functions (^{3}R=O*) to its ground state.

To measure chemiluminescence, a novel apparatus was developed at the *Berne University of the Arts* (Switzerland). Preliminary data acquired with this prototype strongly supports the use of the chemiluminescence method to characterise oxidation reactions and to determine the effects of conservation procedures on objects. Combining the insights gained under realistic conditions with an isoconversional analysis (after Friedman and Ozawa-Flynn-Wall of experimental kinetics) promises to be a powerful tool for prediction of life expectancy.

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