Multispectral Investigations for Characterizing UV-light Degradation of Modern Art Materials

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Since the last century, the world of cultural heritage especially in the field of contemporary art is constantly evolving and synthetic polymeric materials in combination with inorganic and organic pigments are preferably used. However, the stability of these paint mixtures towards the atmospheric environment and light irradiation is not completely understood yet. For this reason, the characterization of the degradation processes of these materials exposed to artificial aging conditions is of significant scientific interest.

In this work, different inorganic pigments (artificial ultramarine blue, hydrated chromium oxide green, cadmium yellow), and synthetic polymeric binders, such as acrylic emulsion and alkyd resin, were exposed to artificial UV-light for 1-6 weeks. To investigate the chemical-physical degradation of paints, ATR-FTIR spectroscopy and Vis-RS spectrophotometry were employed.

The results obtained yield information concerning the chemical stability of different inorganic pigments mixed with polymeric binders. Furthermore, the paint layers degradation vary according to different pigment/binder ratios (P/BM) and degradation processes occurring on the surface (layer thickness around 0.65 μm) considering the color changes can be characterized.

In addition to these traditional spectroscopic techniques, most used in the field of cultural heritage, also Laser-Induced Breakdown Spectroscopy (LIBS) was applied. LIBS offers the possibility to perform elemental analysis and enables measurement of depth profiles.
Moreover, specific regions in the LIBS spectrum can be used to identify and characterize molecular changes in the paint mixtures. Depth analysis of degradation changes in the polymer network, also due to the different influence of the inorganic pigments, were analyzed and evaluated by multivariate statistics too.

From the artistic point of view, these results can help the development of new suitable preventive conservation strategies and this knowledge can be used to understand the chemical-physical stability of these materials. Furthermore, from the industrial point of view, they can be used to improve the quality and stability of synthetic materials.