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LASER TECHNOLOGIES.

LASERS AND THEIR APPLICATION

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The effect of laser radiation on the properties of paint components, studied using the EMR method

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EMR (Electron Magnetic Resonance)

Electron magnetic resonance spectroscopy is based on the resonant absorption of a microwave radiation (E=hν) by paramagnetic atoms or molecules when placed in a strong magnetic field (B). The relationship between ν and B.

Continuous-wave EMR spectra are typically recorded by sending a fixed value of microware radiation, while scanning the magnetic field. A spectral absorption appears when Equation (1) is satisfied. Spectral absorptions appear as first derivatives of an absorption as a function of B because magnetic field modulation and phase sensitive detection at the modulation frequency are employed to improve the signal-to-noise ratio in a spectrum. Characteristic line parameters can be determined from the shape of the line. The value of the resonant field Br, which allows us to determine the effective spectroscopic splitting coefficient gef, the width of the resonant line ΔBpp, and the intensity of EMR line I (see Fig. 1).

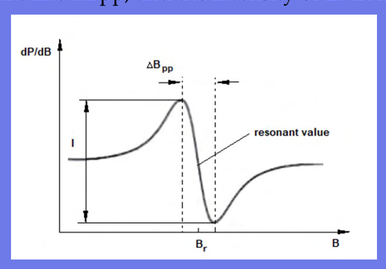


Figure 1. Parameters of the EMR line, the resonance field Br, the width of the resonance line ΔBpp, and intensity I

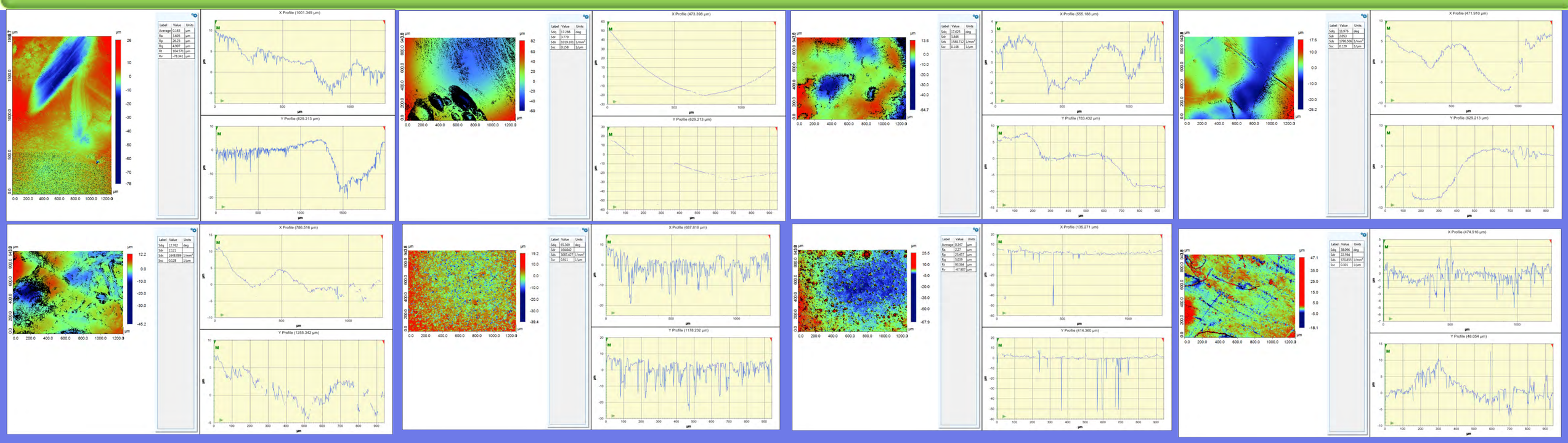
Figure 2 Spectrometer EPR

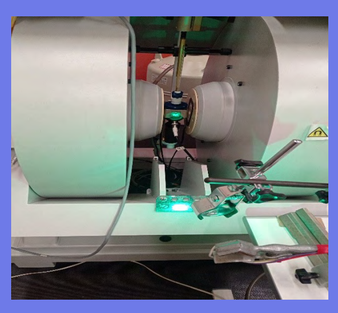
Paints

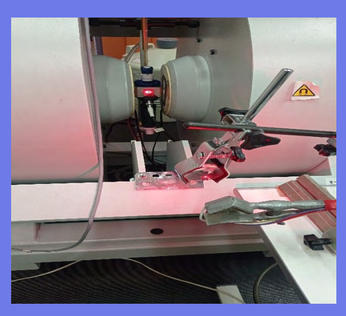
Paints play an important role not only in the arts, but also in materials engineering, for example, with vibration absorbing, in mechanical engineering, shipbuilding, armaments or aerospace. The development of paints is strongly influenced by characteristics such as environmental protection, corrosion resistance, and durability against atmospheric agents; hence, the selection of components most sensitive to degradation is very important.

Paint is a chemical product composed of many raw materials. The properties of paint are determined by the binder, the ingredient that forms the paint layer. The main substance of the binder is a synthetic resin. The binder gives the paint its film-forming properties (drying), physical characteristics (film durability and adhesion), and chemical characteristics (film durability and chemical resistance). Binders and film-forming substances are found in all types of paints, varnishes, and emulsions. They cause the formation of a thin film (known as a film-forming film) on the surface of the item to be painted and are intended to give the paint appropriate properties such as gloss, durability, adhesion, weather resistance, strength, and elasticity. Substances that can act as binders in paints are synthetic or natural resins, such as polyurethanes, polyesters, vinyl/ethylene acetate (VAE), silanes, epoxy resins, or oils, for example. Pigment prevents rusting and gives the paint its color. Pigments are fine, light-resistant coloring particles that do not dissolve in water or other solvents. They can be divided into three classes: coloring pigments, anticorrosive pigments, and filler pigments. Color pigments impart color to paint, and include, for example, titanium white, carbon black, yellow ochre, carbon blue, cyanine green, and quinacridone red. Anticorrosion pigments include aluminium phosphate, zinc molybdate, and zinc dust. The filling pigments determine the properties of the film. Examples include matting pigments that affect the gloss of dried paint, functional pigments such as aluminium powder and fluorescent or phosphorescent pigments, and special pigments such as infrared reflectants and radio frequency absorbers.

Research







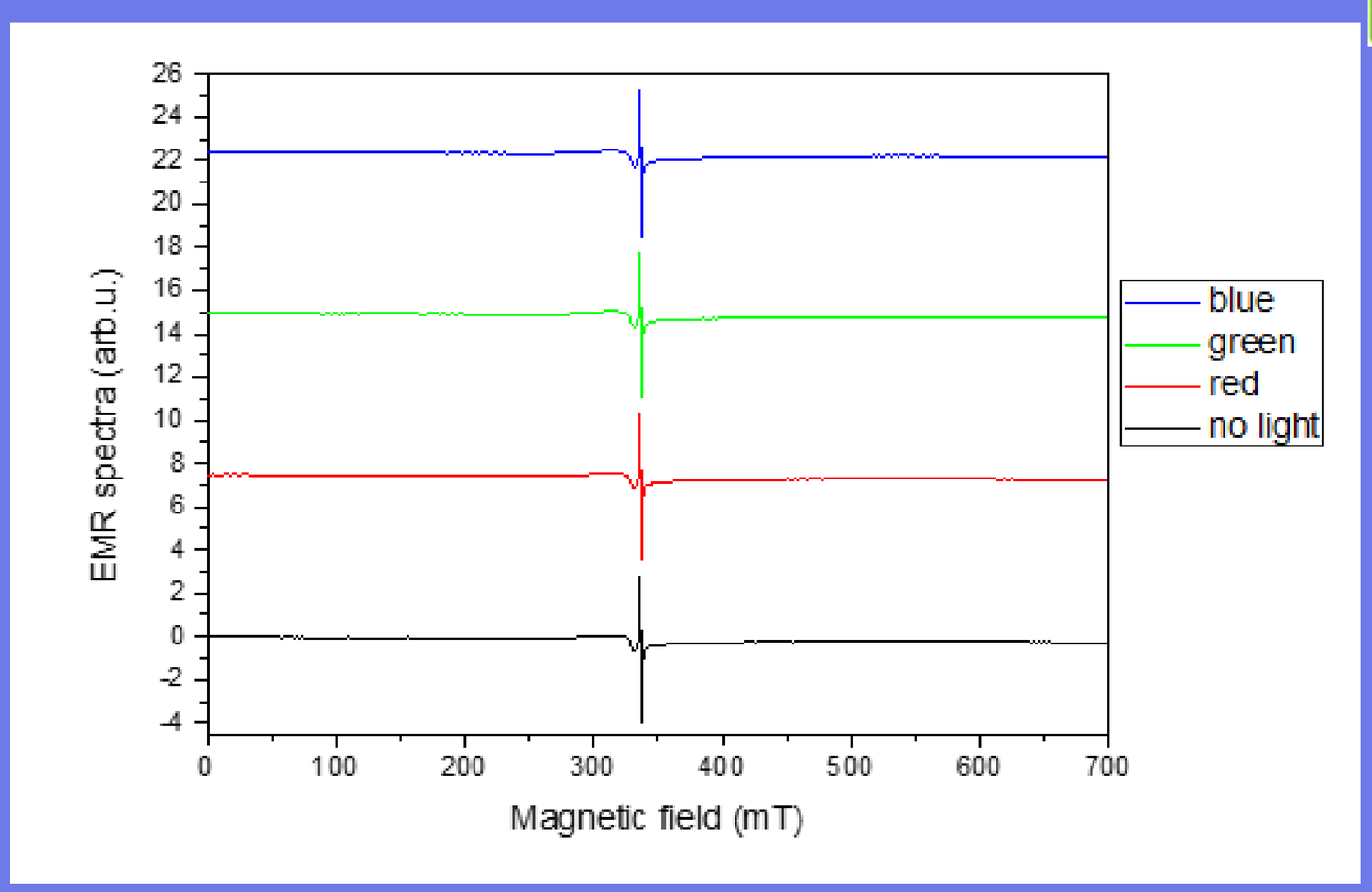


Figure. EPR spectra of 2K acrylic paint, purple pigment paste, effects of laser radiation at different wavelengths

Conclusions

Electron magnetic resonance (EMR) spectroscopy is the best nondestructive method for testing paint components . EMR can detect any species with paramagnetic electrons, including organic and inorganic radicals, transition metal complexes [1], metalloproteins, and biradicals.

The EMR of the degradation of varnish components under the influence of laser radiation was studied. Measurements were carried out to evaluate the durability of pigments exposed to laser light. EMR line parameters and g-factor were determined. Electron magnetic resonance is the best method of evaluating paint components during irradiation with laser light.

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