UNIWERSYTET
MIKOŁAJA KOPERNIKA
W TORUNIU

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Imię i nazwisko doktoranta: Anna Faron

STRESZCZENIE ROZPRAWY DOKTORSKIEJ

Dyscyplina naukowa: sztuki plastyczne i konserwacja dzieł sztuki

Tytuł rozprawy doktorskiej: ***Możliwości wykorzystania innowacyjnego lasera o bardzo dużej częstotliwości powtarzania pulsów z rotacją wiązki w konserwacji polichromowanych i werniksowanych obiektów dziedzictwa kulturowego.***

(ang.): Possibilities of using a very high pulse repetition rate laser with beam rotation in the conservation of polychromed and varnished cultural heritage objects.

Streszczenie rozprawy doktorskiej w języku angielskim:

The thesis investigates the implementation and safety of laser ablation in heritage conservation, namely implementation of an innovative fiber laser with a very high pulse repetition rate and beam rotation. The introductory section emphasizes the growing importance of laser technology as a non-contact, precise, and increasingly widely used method in conservation practice. The theoretical part reviews the fundamentals of laser cleaning, its history, and its effectiveness compared to conventional methods, focusing on polychrome and varnished artifacts. At the same time, it identifies a significant research gap regarding fibre lasers, which—despite their growing popularity—have not yet been comprehensively addressed in the scientific literature.

The experimental section focuses on evaluating the RedEnergy G4 EP-Z pulsed fibre laser system (1064 nm). It introduces specialized control and simulation software and analyzes how specific laser parameters affect cleaning outcomes on model samples. A major part of the study examines the optical stability of seventeen traditional pigments and dyes under infrared laser radiation. Finally, the practical application of this technique is demonstrated through case studies involving the cleaning of polychrome wooden objects, overpaint removal, gilded surfaces, paintings, and coated historical papers. In the conclusions section, the author demonstrated that the applied fibre laser enables effective, selective, and controlled removal of surface deposits while minimizing the risk of damage to

the original historic material. The safety of the treatment depends largely on the precise adjustment of beam parameters, such as fluence, frequency, and scanning speed, individually tailored to the type of material and the structure of the object. The thesis concludes with comprehensive guidelines for safe laser conservation.

The research results also confirmed the necessity of using advanced monitoring methods, which allow ongoing control of the cleaning process and assessment of changes occurring in the material. It was emphasized that this technology—despite its high potential—requires informed and cautious application, taking into account the specific characteristics of each conservation case.

The dissertation makes a significant contribution to the development of modern methods of art conservation, providing both the results of fundamental research and practical recommendations for the application of fibre lasers in the conservation of cultural heritage.

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podpis doktoranta