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ABSTRACT

PRESENTATION

PAPER

Pablo Venegas received the PhD degree in industrial engineering from the Faculty of Engineering of the University of the Basque Country (UPV-EHU), in Leioa, Spain in 2006 and the master's and PhD degrees in industrial technology research from the National Distance Education University (UNED) in Madrid, Spain in 2012 and 2019, respectively. He has many years of experience in the aeronautical sector in the research and development of infrared thermographic technology applied as non-destructive testing tool and in the execution of structural tests for the development and certification of aeronautical components and materials. He is currently working at the Aeronautical Technologies Center Foundation (CTA) in Miñano, Spain.

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INFRARED THERMOGRAPHY CHARACTERIZATION OF SMART MULTI-FUNCTIONAL MATERIALS FOR THE AERONAUTICAL INDUSTRY

The use of multimaterial structures at an industrial level, the ability to join different materials and keep them together throughout the structure's lifespan, or to separate them for repair or recycling at the end of their life, are fundamental aspects to enable a smart industry aligned with sustainable development goals. Conventional joining technologies, such as welding, mechanical fastening, or adhesive bonding, do not meet these conditions. Welding, for example, provides a strong but permanent joint and is not applicable to all types of materials, such as thermosets. Mechanical fastening allows for component repair and reuse; however, in some materials, this type of joint is not possible due to stress concentration at certain points or aesthetic concerns. Adhesive bonds (generally with thermosetting polymers) are strong but flexible, can dampen noise, are insensitive to many corrosive environments, preserve surface aesthetics, and allow for uniform stress distribution across the entire contact area, without significantly increasing the structure's weight. However, adhesive bonds are often permanent, making the removal of components for repair or replacement impractical.

In recent years, significant efforts have been made in the development of dynamic covalent networks, which are networks crosslinked covalently like thermosetting polymers, offering notable recyclability based on exchange reactions of the bonds. Current stimuli to induce these exchange reactions mainly include heat and light. The use of light has the disadvantage of relatively poor penetration into a piece, making heat a advantageous option for achieving these changes. The possible heating through a magnetic field of these networks has been previously demonstrated, although it has not been related to the adhesive properties of the network itself, making the development of reversible adhesives based on dynamic networks and the use of hyperthermia induced by the inclusion of magnetically active nanoparticles inside a novel technology.

The aim of this study is to harness the effects associated with the presence of magnetic nanoparticles (MNPs) such as hyperthermia, solar adsorption, controlled activation, etc., to develop new intelligent multifunctional materials for the industry. More specifically, the proposal is to create a reversible adhesive based on the presence of dynamic covalent networks and the incorporation of magnetic nanoparticles and hyperthermia generated by an electromagnet. The incorporation of nanoparticles into various types of thermoplastic adhesives (olefin-based hot melt adhesives, ABS, etc.) or thermosetting adhesives with reversible bonds is studied. The effect of nanoparticle concentration on the mechanical and adhesive properties of the materials, curing or heating time, as well as the speed at which the bond disappears and regenerates, and the behavior of the bond after several cycles of bonding/unbonding are analyzed.