BEHAVIOR ANALYSIS OF COMPOSITE IN CURE PROCESS FOR RAPID PROTOTYPING

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ABSTRACT

Rapid Prototyping consists on a set of technologies that allows to fashion physical 3D models straight from an initial project in CAD (Computer Aided Design) format. Stereolithography is a process that favors high dimensional precision, good space resolution and short time for the final product. The physical 3D models building occurs over a polymeric layer which is compounded by 3 elements including epoxi resin and silica that can be incorporated into microscopic devices to yield novel properties, such as increased toughness, high mechanical properties, high deflection temperature, high chemical resistance, low thermal expansion, magnetism and high electrical insulation. The analysis in our lab run around a permutation of the fraction of each composite. The kinetic parameters (reaction rate, activation energy and heat of reaction) for the material were determined by using a differential scanning calorimeter (DSC). By employing DSC, both dynamic and isothermal mode were conducted and analyzed, made use of associate between the energy released in curing process with the fractional conversion of curing kinetics. The tests performed with a linearly increasing (or scanned) temperature were able to determine the enthalpy involved in the phase transition. Another series of experiments data, involving isothermal cures, were carried out to obtain the conversion reached at several cure temperatures and the reaction rates. Arrhenius equation is valid to estimate the activation energy. A new kinetic model was applied to study the curing kinetics and describe the main features of the curing process, namely diffusion-controlled effects after vitrification and incomplete conversion, presenting an excellent agreement with experimental and predicted values. Finally, 3D structures in the rapid prototyping process were fabricated.