Development of low-temperature automotive clearcoats using dual-curable blocked isocyanate crosslinkers

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The typical curing conditions (e.g., 150 °C for 30 min) of various automotive coatings need be effectively lowered for solving the emerging ecological and environmental issues in related industries. To preserve mechanical and thermal properties of coatings under low-temperature curing processes, first of all, new curable coating materials should be developed. In this study, low-temperature curable blocked isocyanate crosslinkers containing thermal radical initiator (TRI) and isocyanate functionalities (-NCO) were prepared for conducting dual curing process by radical and urethane reactions. Hydroxyl functionalized urethane methacrylate oligomer with methacrylate (C=C) and hydroxyl (-OH) groups was used as a main binder. The low-temperature curing characteristics of automotive clearcoats with new hybrid crosslinkers were analyzed in real time, using a rotational rheometer and a rigid-body pendulum tester. Surface mechanical strength and scratch resistance were done on fully-cured clearcoat films via nano indentation and scratch tests. Rheological and thermal analyses of clearcoat films clarified the role of prepared blocked isocyanates in low-temperature curing technology.