

Piezoelectric smart sensor for impact monitoring for railroad vehicles

Kyungwho Choi¹, Donghoon Kang², Lae-Hyong Kang³, Dahoon Ahn⁴

¹Future Innovation R&D Strategy Division, Korea Railroad Research Institute, Republic of Korea, ¹-, Korea Railroad Research Institute, Republic of Korea, ¹Department of Flexible and Printable Electronics Engineering, Chonbuk National University, Republic of Korea, ¹Department of Mechanical System Design Engineering, Seoul National University of Science and Technology, Republic of Korea

When a train is running at high speed, the aerodynamics of fast moving trains cause gravels to hit the side of the coach and break the windows. Moreover, the flying ballast can hit the underside of the bogie or electronic parts installed there. Extensive researches have been conducted to reduce the damage caused by this phenomenon. In this study, we fabricated “smart paint sensors” for impact monitoring using piezoelectric nano powders and commercial paints for railroad cars and then analyzed the application of impact monitoring for rolling stocks. Commercial paint simplifies the process by eliminating the need to apply additional layers of functionalized paint. In addition, the smart piezoelectric paint sensor can be evenly sprayed on a large surface which was suitable for application on large and complex objects, such as railroad bogies. Because railroad vehicles are exposed to severe climate environment for a long time, thermal fatigue tests were conducted to determine the stability of polymer-based materials that are relatively vulnerable to temperature changes. Test results were used to analyze the impact sensitivity of piezoelectric paint sensors. For the analysis, a shock monitoring system with a full-size model of the rolling stock bogie and piezoelectric paint sensors was implemented to visualize the impact signals from different shaped objects with large surfaces.