



## Development of polycarbonate/acrylonitrile–butadiene–styrene copolymer based composites with functional fillers for car audio chassis

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### ABSTRACT

Environmental regulations require the improvement of automobile fuel efficiency. This can be achieved mainly by reducing the weight of automobile components. In this study, polycarbonate/acrylonitrile–butadiene–styrene copolymer (PC/ABS) based composite mixed with glass fibers and metal fibers was developed and its suitability of application into car audio chassis was investigated. The test materials were prepared with various contents of metal fibers because of the fibers' excellent mechanical and electrical properties. In this study, the morphologies of the materials were investigated to confirm the dispersion of the fillers and the interfacial characteristics between the fillers and the base material. In addition, the mechanical and electrical characteristics of the PC/ABS based composites, which depended on the metal fiber content, were evaluated using key mechanical (impact, tensile and flexural) and electrical tests such as electromagnetic interference (EMI) and surface resistance. The proper proportion of the metal fibers in PC/ABS based composites was determined from the test results. Finally, the applicability of PC/ABS based composites in car audio chassis was evaluated through weight reduction analysis and cost-benefit analysis.

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### 1. Introduction

The automotive industry spends a lot of effort to develop light-weight vehicles with high fuel efficiencies. Under international environmental regulations, such as the 2005 Kyoto Protocol, it has become especially important to develop so-called “green cars”, which have high efficiency and low fuel consumption [1,2]. Currently, the industry is working on developing many automotive parts using lighter materials, such as aluminum and engineering plastics, to replace conventional steel parts [3].

Steel has long been used to make car audio chassis because of its good mechanical properties in severe driving conditions and high effectiveness in electromagnetic interference (EMI) shielding, which satisfy regulations [4]. As part of the automotive industry's trend toward “green cars”, reinforced engineering plastics are sought as substitute materials for car audio chassis, which are traditionally made from carbon steels. Development of engineering

plastics to replace steel in car audio chassis requires the following considerations: (1) high thermal resistance to the heat generated from the engine, (2) superior mechanical properties against external vibrations and impacts, (3) good EMI shielding characteristics, (4) light weight and (5) low cost. EMI shielding is particularly important because of the strictly regulated international standard on EMI shielding effectiveness (SE) for any electronic devices. In addition, a good balance of mechanical stiffness and strength in car audio chassis is needed to satisfy the vibrational requirements of car audios.

In this study, a polycarbonate/acrylonitrile–butadiene–styrene copolymer (PC/ABS) based composite was developed with some functional fillers. As the base material of the composite, PC/ABS was chosen because of its good mechanical properties [5] and injection moldability [6] suited for producing complex-shaped car audio chassis.

Three functional fillers were selected to meet the requirements described above. First, glass fibers (GF) were used to improve the mechanical strength and stiffness of the polymer composites [7]. Although there are many functional fillers (e.g., carbon fibers) that have better mechanical properties than glass fibers, glass fibers are commonly used because they are less expensive [8]. Second, metal fibers (MF) were added to the composites to balance the mechanical and electrical properties as well as the thermal conductivity.

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