

Development of Next-Generation Calcium Carbonate for Reinforcement of Natural Rubber Composites

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The increasing demand for green and sustainable materials has expanded across the global market. Among these materials, natural rubber (NR) is a renewable and biodegradable polymer widely used in various industrial sectors. Although NR exhibits excellent elasticity and flexibility, reinforcing fillers are still required to enhance its mechanical performance. The reinforcing efficiency depends not only on particle size, but also on filler dispersion and the compatibility between the filler and the NR matrix. Calcium carbonate (CaCO_3) is a low-cost and abundant mineral material naturally available in the environment. It can also be synthesized through a simple chemical precipitation method involving calcium ions (Ca^{2+}) and carbonate ions (CO_3^{2-}). Through this method, the crystal structure, particle shape, particle size, and surface properties of CaCO_3 can be controlled by adjusting parameters such as reactant concentration, mixing speed, and reaction medium.

In this study, spherical CaCO_3 particles with submicron particle size were successfully synthesized using CaCl_2 and $(\text{NH}_4)_2\text{CO}_3$ solutions, both without and with surface modification using olive soap to alter the surface polarity of the CaCO_3 particles. The mechanical properties of NR composites containing unmodified and modified CaCO_3 were investigated at filler loadings ranging from 0 to 60 phr. The results revealed that the NR composites filled with modified CaCO_3 exhibited higher tensile strength than those containing unmodified CaCO_3 and pure NR at all filler loadings. These findings suggest that the synthesized spherical CaCO_3 has strong potential as a next-generation reinforcing filler for sustainable NR composites with broader industrial applications.

Reference 1) K Longkaew, A. Gibaud, W. Tissanan, P. Daniel and P. Phinyocheep, *Polymers*, 15(2), 4287 (2023).

Biography (For Plenary, Keynote, and Invited Speakers)

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Personal History:

Dr. Pranee Phinyocheep is a Professor in the Polymer Science and Technology Program, Department of Chemistry, Faculty of Science, Mahidol University, Thailand. She has been working on the chemical modification of natural rubber for nearly three decades, investigating various modification techniques in both latex and organic phases. Her research focuses on adding value to natural rubber through the development of materials such as epoxidized natural rubber, low-molecular-weight natural rubber, and photosensitive liquid natural rubber. She has applied these functionalized natural rubbers as toughening agents for plastics, including poly(lactic acid), as well as in epoxy coating materials. In addition, she has expanded her research into bio-based composites reinforced with natural fibers and calcium carbonate. She got a B.Sc. in Chemistry and a Master's degree in organic chemistry from Mahidol University and then went to study a Ph.D. in Polymer Chemistry at Le Mans University, France. She has been working at Mahidol University since 1988 up to now.

Research Keyword (3-5 keywords use commas to separate each word):

Modification of natural rubber, Rubber composite, Surface Coating,