

## Preparation and Properties of Rubber/Montmorillonite Composites

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**Abstract:** Rubber/ultrafine fully vulcanized nitrile rubber (UFPNBR)/montmorillonite (MMT) composites and rubber/organic MMT (OMMT) composites were prepared by using nitrile rubber (NBR), styrene butadiene rubber (SBR) and ethylene propylene diene monomer rubber (EPDM) as matrix materials. The microstructure and morphology, physical properties and air tightness of the composites were investigated. The results showed that MMT was exfoliated in the rubber matrix in the rubber/UFPNBR/MMT composites. In the NBR/OMMT composites, the OMMT interlayer spacing was large. The physical properties and air tightness of the composites were improved when the addition amount of MMT was increased, but the improvement of the SBR/MMT composites was less than that of NBR/MMT. It was found that OMMT presented significant reinforcement on EPDM rubber. However, UFPNBR/MMT powder showed very little reinforcement on EPDM. Compared with the EPDM/UFPNBR/MMT composites with a weight ratio of UFPNBR and MMT at 1/4, the air tightness of the EPDM/UFPNBR/MMT composites with a weight ratio of UFPNBR and MMT at 1/1 was better.

**Key words:** montmorillonite; ultrafine fully-vulcanized powder nitrile rubber; nitrile rubber; styrene-butadiene rubber; ethylene propylene diene monomer rubber; microstructure and morphology; air tightness

### 美科学家研发出生物基异戊二烯

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在美国国家科学基金会的资助下,美国明尼苏达大学化学工程与材料科学系Paul Dauenhauer博士为首席研究员的专题研究团队开发出一种由树木、杂草和玉米等农作物生产异戊二烯的技术。这项突破性的研究成果已发表在美国化学学会的《ACS Catalysis》上。

众所周知,传统的异戊二烯生产工艺是将石油类原料裂解,再从数百种裂解产物中分离出异戊二烯并纯化。异戊二烯单体发生聚合反应生成固态高分子聚合物。业已证明,用这种从生物类物质中衍生出的异戊二烯聚合制得的聚异戊二烯橡胶与用传统的石油系原料制得的聚异戊二烯橡胶具有相同的化学成分、色泽和性能。

过去十年来,合成橡胶生产商与轮胎制造商多次尝试利用微生物发酵技术从生物类物质中生产异戊二烯。然而,实践表明,用微生物发酵法很难可持续性地生产异戊二烯单体。

明尼苏达大学研究团队采用3个步骤将微生物发酵与常规催化精制过程有机地结合起来。第1步是将来自于生物质的糖类(如葡萄糖)发酵,生成衣康酸(itaconic acid)的中间体。第2步是将这种衣康酸与氢反应,生成化学名称为甲基四氢呋喃的化合物。第3步是用明尼苏达大学最近发现的名为“含磷自柱式五元环结构单元”的分子筛(P-SPP,即Phosphorus Self-Pillared Pentasil)为催化剂,将甲基四氢呋喃脱水,最终生成异戊二烯。利用这种P-SPP分子筛可使催化效率提高至90%。

目前,该生物基异戊二烯生产工艺的基础研究工作仍在继续进行。下一阶段,研究人员将开展工业化规模生产工艺的设计与开发工作。明尼苏达大学已为这项生物基异戊二烯生产技术申请了专利,并有意将该项技术转让给商业化运作公司。

(郭隽奎)