

RIGID PLASTIC FLEXES ITS MUSCLES FOR STRUCTURAL APPLICATIONS

Cheap and durable, plastic has an amazing track record in replacing a wide range of metals. However, it falls short in applications requiring a combination of high strength and stiffness. For example, under heavy loads plastic without enough stiffness bends. To compensate for this problem, material processors often add glass and carbon fibers—an expensive, additional manufacturing step—to stiffen plastic.

With BMDO SBIR funding, Maxdem, Inc. (San Dimas, CA), developed a new family of rigid-rod polymers that are more than four times stiffer than conventional plastic materials. Called Poly-X™ Self-Reinforced Polymers (SRPs), these inexpensive, durable materials could replace structural materials—including certain types of aluminum and stainless steel—particularly in automotive, aerospace, and defense applications. They also could substitute for expensive fiber-reinforced composites.

For example, the company is working to develop a Poly-X SRP resin to replace the fiberglass sheet molding compound (SMC) used in automotive body panels. Unfilled Poly-X plastics could decrease vehicle weight and facilitate recycling, impossible with current SMCs because of their high fiberglass content.

In another application, Poly-X SRPs could work in laminate form for printed circuit boards and electronics connectors. These harder, more abrasion-resistant polymers could also make highly scratch-resistant windows for automobiles, airplanes, machinery, and windows. The polymers might also be used for brakes, clutches, and other parts.

Funding from the BMDO SBIR program is helping Maxdem to scale up the Poly-X SRP production process, to bring Poly-X SRPs to market. Currently, Maxdem's small-scale production facility regularly produces 22-pound batches of the polymers. It supplies these batches to companies that may develop new applications. According to Maxdem's projections, Poly-X SRPs will cost \$10 to \$12 per pound when production achieves 5 million pounds per year.

ABOUT THE TECHNOLOGY

Poly-X SRPs are rigid-rod polymers with exceptional strength and stiffness. For example, the elastic modulus, or stiffness, of Poly-X SRPs ranges from 1 to 2.5 million pounds per square inch (psi). In contrast, the modulus of conventional engineering resins ranges between 300,000 to 600,000 psi. Unlike liquid crystal polymers, whose strength lies in one direction, Maxdem's rigid-rod materials are equally strong in all directions.

Poly-X SRPs are unique thermoplastic resins based on amorphous rigid-rod polymers. These polymers possess carefully chosen pendant side chains (the flexible component) to impart tractability to the rigid-rod polyparaphenylene backbone. Maxdem's proprietary production process ensures the isometric integrity of the rigid-rod structure. Therefore, homopolymers (the repetition of a similar molecular chain) and copolymers (the repetition of two or more molecular chains) can readily be prepared.

. . . rigid-rod polymers, over four times stiffer than conventional plastic materials, that could compete with some types of metals.

MAXDEM SUPPLIES
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SRPs TO COMPANIES
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■ Maxdem's Poly-X™ SRPs can be fashioned into molded parts and composites, as shown above. They also can be made as resins, pellets, films, and solutions.