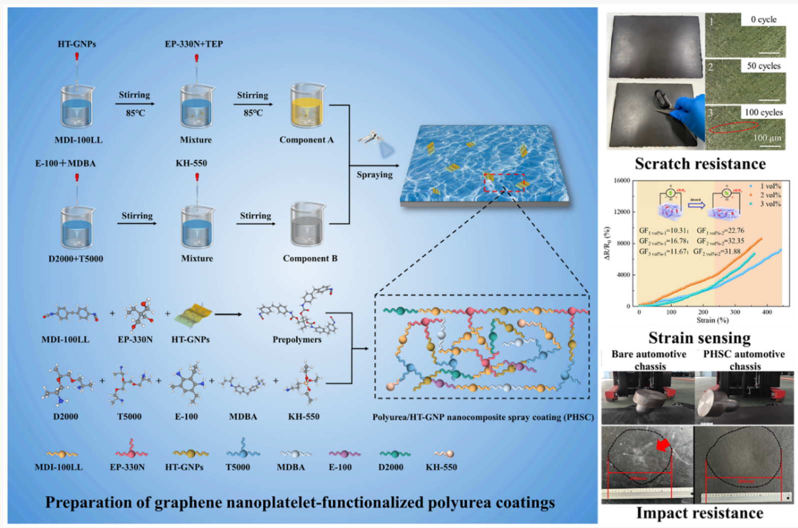
Impact-resistant polyurea coating that senses damage in real time

FAYETTEVILLE, GA, UNITED STATES, January 9, 2026 /EINPresswire.com/ -- Researchers have created a spray-on polyurea nanocomposite coating reinforced with functionalized graphene. The coating delivers high strength and stretchability, strong adhesion across substrates, and durable performance after heat, salt-spray, and UV aging. It also resists corrosion and provides fast, reliable strain sensing for real-time damage detection—offering a scalable protective coating for infrastructure and automotive structures.



Preparation and Main Properties of Graphene NanoPlatelet-functionalized Polyurea Coatings.

Harsh environments and complex geometries make it difficult to deploy structural health monitoring at scale, as conventional sensors have poor conformability, mechanical properties, and weather-resistance. In a study published in the KeAi journal Advanced Nanocomposites, a research team outlines a new approach they have developed—a spray-applied polyurea nanocomposite sensing coating reinforced with functionalized graphene, designed to combine robust mechanical protection with real-time damage amd strain monitoring for infrastructure and automotive structures.

“Our work introduces a spray-applied polyurea-based nanocomposite sensing coating that integrates covalently functionalized graphene nanoplatelets into a two-component polyurea matrix—improving processability for scalable deployment, enhancing weatherability for long-term outdoor service, and establishing a robust conductive network that delivers strong, reliable resistive sensing,” explains corresponding author Qingshi Meng, a professor of aerospace engineering at Shenyang Aerospace University.

The research team found that covalently functionalizing graphene nanoplatelets with an HDIT trimer allowed the fillers to disperse uniformly and become chemically integrated into a fast-curing, two-component spray polyurea network. This molecular “anchoring” strengthens the hydrogen-bonded microstructure and helps form a stable, low-threshold conductive pathway even under rapid spray gelation—enabling robust resistive sensing while maintaining mechanical toughness, strong adhesion, and durable weather and corrosion protection on real, complex substrates.

“Until now, scalable strain-sensing coatings have often faced a trade-off between easy spray processing, long-term weather resistance, and reliable electromechanical performance,” Meng notes. “By using covalently functionalized graphene to build a stable conductive network within a sprayable polyurea, we show these requirements can be met simultaneously.”

The team hope their results would encourage wider exploration of molecularly engineered nanofillers to create durable, multifunctional coatings for infrastructure and automotive health monitoring.

References
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