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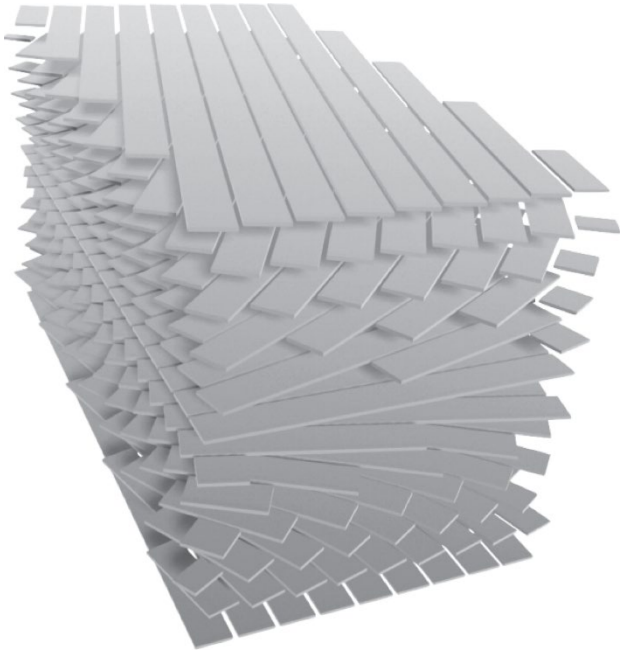
WM-2306: Tape-Based Quasi Composites

Inventors: Benjamin Skopic, Hannes Schniepp

Applications: Materials, Polymers, Composites

Key Innovations

- **Revolutionary Material Design**: Tape-based quasi-composites are a novel class of structural materials that combine strength and toughness using known materials and without requiring a traditional binding matrix. Layers of parallel, ribbon-shaped materials are arranged at angles relative to adjacent layers, with optional use of binding agents between layers. The resulting composite materials provide extraordinary gains in toughness.



- **Self-Adhesive Mechanism**: The innovation leverages direct tape-to-tape adhesion (via van der Waals forces or welding) to transfer load efficiently, eliminating the weaknesses introduced by traditional fiber-matrix interfaces.
- **Customizable Properties**: By varying the angle and adhesion between tape layers, these composites offer tunable mechanical properties, enabling applications requiring specific strength, toughness, or failure characteristics.

Competitive Edge

- **Unparalleled Mechanical Performance**: Tape-based quasi-composites exceed the tensile strength and toughness (see table below) of traditional fiber-reinforced composites by directly leveraging tape-to-tape interactions.
- **Versatility Across Materials**: Can be manufactured from various polymers, metals, or carbon-based materials, allowing adaptation to diverse industry needs.
- **Isotropic Properties**: Unlike many composites that are directionally dependent, these materials can be engineered for uniform performance in all directions.

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Quasi-Composite	Rotation Angle (°)	Toughness (kJ/m^3)	Tensile Strength (MPa)	Modulus (GPa)
Single Tape	-	222 ± 45	23.3 ± 1.1	1.48 ± 0.05
Stacked	15	792 ± 75 (256.2)	29.6 ± 1.1 (27.2)	1.27 ± 0.04 (-14.3)
	30	787 ± 126 (253.8)	29.6 ± 1.2 (27.2)	1.27 ± 0.07 (-14.3)
	45	805 ± 85 (262.1)	30.6 ± 0.6 (31.5)	1.34 ± 0.04 (-9.1)
	90	423 ± 62 (90.0)	24.2 ± 1.6 (3.9)	1.05 ± 0.07 (-28.8)
Welded	15	870 ± 69 (291.3)	27.0 ± 1.3 (15.9)	1.48 ± 0.07 (0.4)
	30	636 ± 46 (186.1)	26.7 ± 1.6 (14.6)	1.51 ± 0.08 (2.0)
	45	497 ± 54 (123.5)	25.1 ± 1.8 (7.9)	1.47 ± 0.07 (-0.6)
	90	264 ± 48 (18.9)	18.3 ± 1.2 (-21.3)	1.28 ± 0.07 (-13.1)

Applications and Markets

- **High-Performance Applications**: Ideal for industries such as aerospace, automotive, sports equipment, and military, where lightweight and durable materials are critical.
- **Sustainability**: Potential for using recyclable polymers or advanced materials like graphene ribbons to create eco-friendly high-performance composites.

Intellectual Property: Pending US patent application 18/754,119

Additional Information: See related thesis

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