The Effects of Different Road Conditions on Piezoelectric Tires

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This project explores how piezoelectricity in electric vehicle tires can generate energy and how different road conditions impact output. Climate change is an ongoing issue, and piezoelectricity offers a clean energy solution by generating electricity from mechanical pressure without harmful emissions. My goal was to determine whether piezoelectric tires could improve electric vehicle efficiency enough to make them viable alternatives to traditional ones. I designed tires that were fitted with a series of PZT ceramics and a foam layer for protection. As the tire rotates, the ceramics compress and generate a charge, while the foam prevents cracking. I built a simple test vehicle and drove it over various surfaces like smooth roads, bumpy roads, wet roads, and snowy/slushy roads. Although the oscilloscope couldn't read the low voltages produced, I calculated theoretical outputs using math and road condition analysis which accounted for various factors like the cushioning effect of snow or slush. Bumpy roads allowed for the highest voltage output due to sharp pressure changes, but I concluded that smooth roads are better overall. Smooth roads allow consistent compression and more stable voltage generation, while bumpy roads cause erratic outputs. Despite limitations, my data suggests piezoelectric systems could have a meaningful impact on electric vehicles because the system was able to harvest energy across all tested road surfaces.

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