MATERIALS AND DESIGN FOR HEAT HARVESTING AND THERMAL MANAGEMENT OF ASPHALT PAVEMENTS

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Asphalt pavements are subjected to annual, seasonal, and daily temperature fluctuations, which can lead to cracks and even failure of the pavements. Additionally, snow removal in winter on highways and parking lots in the cold-climate region is often challenging and the current snow removal approaches (salt and plowing) are neither efficient enough nor environmental-friendly. Here we propose a multifunctional system that utilizes solar and geothermal energy for heat harvesting and temperature regulation of the pavements, which allows self-de-icing in winter, cooling in summer, reduced maintenance cost, and extended life span. This new pavement technology consists of an underground heat exchanger, circulation pumps, thermal tubes, a photovoltaic system, and thermally conductive pavement overly. This presentation will focus on investigation of the thermal, electrical, and mechanical performance of the asphalt materials modified with conductive additives including carbon nanotubes and graphene nanoplatelets. Using sonication combined with an oil bath and a mechanical shear mixer, we can achieve a homogenous dispersion of the conductive modifiers in asphalt binders, which is verified by a digital microscope. Our results show that the combination of carbon nanotubes and graphene nanoplates can enhance the thermal conductivity of the asphalt binders more than any of the single-phase addition. More work on the electrical conductivity improvement in using these modifiers are underway. These modified asphalt binders are expected to increase asphalt pavements' overall thermal conductivity, which is an integral part of the multifunctional pavement system.