

Thermal Conductivity Optimization of Molten Salt Nanofluids for Concentrated Solar Power

Quynh Kim*

Department of Physics, Shanghai Jiao Tong University, Shanghai, China

DESCRIPTION

Energy is the foundation of modern civilization. Every aspect of human development industry, transportation, healthcare, and communication depends on reliable and affordable energy sources. For over two centuries, fossil fuels such as coal, oil, and natural gas have powered global growth. However, this dependence has come at an enormous environmental cost. Rising greenhouse gas emissions, air pollution, and climate change now threaten ecosystems and human societies worldwide. In response, the world has turned its focus toward renewable energy derived from natural resources that replenish continuously and produce little to no emissions. Renewable energy is not merely an alternative to fossil fuels and it represents the future of sustainable development and the key to a cleaner, more resilient planet.

Renewable energy refers to power generated from sources that are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves, and geothermal heat. Unlike finite fossil fuels, these resources are abundant and widely distributed across the planet. Solar energy has the potential to meet global electricity demand many times over. The challenge lies in improving storage technologies to address intermittency the variability of sunlight due to day-night cycles and weather conditions.

Wind energy converts the kinetic energy of moving air into mechanical power using wind turbines. When grouped into wind farms, these turbines can generate large amounts of electricity. Wind energy is clean, efficient, and increasingly cost-competitive with fossil fuels. Offshore wind farms constructed in oceans or seas can capture stronger and more consistent winds, further boosting output. Geothermal energy taps the Earth's internal heat, using steam or hot water from underground reservoirs to produce electricity or provide direct heating. It offers a consistent and reliable energy supply, unaffected by weather variations.

Advances in drilling and Enhanced Geothermal Systems (EGS) are expanding access to deeper and previously unreachable heat sources. Although initial setup costs are high, geothermal

energy's long lifespan and low operating costs make it economically attractive in the long term. The rapid expansion of renewable energy is largely due to innovation. Technological advances have reduced costs, improved efficiency, and expanded the possibilities of clean power. Modern solar cells use new materials such as perovskites for greater light absorption, while advanced wind turbines now operate efficiently at lower wind speeds.

Energy storage technologies especially lithium-ion and flow batteries are revolutionizing how energy is managed. Smart grids equipped with digital sensors and artificial intelligence enable real-time monitoring and energy optimization. Additionally, hydrogen produced from renewable electricity (green hydrogen) is emerging as a potential fuel for industries and transport sectors that are difficult to electrify. These innovations show that technology and sustainability can progress together, creating the way for a resilient and flexible energy future.

As renewable technologies mature, costs will continue to fall and efficiency will improve. The world's energy future will depend not only on innovation but also on collective willpower to prioritize sustainability over short-term profit. Renewable energy represents the cornerstone of a sustainable and equitable future. From solar and wind to geothermal and biomass, renewable sources provide clean, reliable and inexhaustible energy for generations to come.

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Correspondence to: Quynh Kim, Department of Physics, Shanghai Jiao Tong University, 800 Dongchuan Road, Shanghai, China, E-mail: kimq@gmail.com

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