Hydrovoltaics

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In contrast to conventional technologies that harvest solar energy by directly converting the energy of light into electrical energy through the photovoltaic effect and kinetic energy of water by mechanical systems, hydrovoltaic effects generate electricity from the direct interaction of graphene and nanostructured materials with water, using the solar energy arriving the Earth indirectly1.

Water is not only the essence of life, but also the largest energy carrier on the earth. Water covers about 70% of the earth's surface, absorbing 70% of the solar energy arriving the earth, and in the atmosphere it can exist in liquid, gaseous and solid states. In human history, through a variety of scientific principles, such as running water driven wheel, steam locomotives, water driven generator as well as the electrokinetic effects, the potential energy or kinetic energy of water can be converted into useful mechanical motion and electrical energy according to the principles of classical mechanics and electromagnetic dynamics2. In the recent decade, hydrovoltaic effects include waving potential3, drawing potential4, evaporation-induced electric potential5 or evaporating potential6 have been found. With hydrovoltaic effects, energy from flowing, waving, dropping, condensing, as well as evaporating water can now be harvested, significantly extending our capability in harvesting environmental energy, leading to the emerging hydrovoltaic technology7 and hydrovoltaics: New ways of harvesting electricity from water8.

In the past years, intensive efforts have been devoted to hydrovoltaics with notable developments made. The power generation has been improved by several orders with incorporation of new materials and devices, putting the Hydrovoltaic Energy on the Way9.

Here, we will review the recent advances in hydrovoltaics for harvesting environmental energy10,11, serving as a potential Negative thermal emission energy technology12, and envision the future directions for hydrovoltaics, from hydrovoltaic energy, to hydrovoltaic ecology and hydrovoltaic intelligence.

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