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EXTENDED PARTICLE DIFFERENCE METHOD FOR SOLVING THE STEFAN PROBLEM

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An Extended Particle Difference Method (EPDM) for solving the Stefan problem is presented in this study. The EPDM is a strongly formulated particle method to inherit the merits of the Finite Difference Method and the Particle Method. It is equipped with the extended particle derivative approximation that is derived by using Taylor series expanded by the Moving Least Squares method [1]. It employs neither grid structure for the construction of approximation function nor cell structure for the integration of weak form. Any cause, which might lessen the merits of particle method like nodal computation or degenerate computational efficiency, is removed in advance. The partial differential equations for Stefan problem are directly discretized to generate difference equations by using an implicit scheme; time integration of the energy conservation equation is carried out by Backward Euler scheme. However, the update of topology change of moving boundary is done by an explicit scheme. Furthermore, it involves no additional interface evolving scheme like Level Set Method [2] that makes the total system more complicated because the kinetics relation of fusion boundary is already immersed in the extended particle derivative approximation. Actually, this aspect adds some more computational efficiency to the method. As a result, assembling the difference equations yields a linear algebraic system. The EPDM successfully traces the topology change of fusion boundary due to phase transformation without burdensome grid or mesh operation and effectively circumvents the difficulties from which the conventional particle methods suffered. Also, compared to the conventional Finite Element Method, the aforementioned aspect can be thought as an outperforming aspect in solving Stefan problem. The accuracy and efficiency of the EPDM in simulating complex topology change in 2-D Stefan problem are clearly shown from various numerical experiments.

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