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Abstract
Peritectic alloys form a variety of different solidification morphologies at low growth rates. An alloy with a concentration that corresponds to the hyper-peritectic limit should show a cellular/dendritic solidification of the peritectic phase for growth velocities above the corresponding constitutional undercooling limit. However, due to nucleation retardation of the peritectic phase we observed growth of properitectic dendrites before cellular growth of the peritectic could established. The transition happened via an overgrowth of dendrites with a thin layer of peritectic phase. The observations were made using a transparent, metal-like solidifying peritectic system that was solidified directionally in thin samples. In the gap between the flat dendrites and the tubing walls, the peritectic phase grew with a compact seaweed morphology, whereas in the interdendritic spacing it formed small-curved bumps. At same distance behind the tip region, more and more polycrystalline-like objects appeared at the elongated traces of the compact seaweed morphology.

Keywords: peritectic solidification, dendritic-cellular transition, seaweed growth

I. INTRODUCTION

In peritectic systems, the properitectic α-phase reacts upon cooling with the liquid to yield the peritectic β-phase at the peritectic temperature T_p. At this distinct temperature, a liquid of concentration $c_{p,l}$ is in equilibrium with an α-phase of concentration $c_{p,\alpha}$ and a β-phase of concentration $c_{p,\beta}$. Alloys with compositions between $c_{p,\alpha}$ and $c_{p,\beta}$ are called hypo-peritectic, those with compositions between $c_{p,\beta}$ and $c_{p,l}$ are called hyper-peritectic [1]. Above the critical growth rate for constitutional undercooling of the two solid phases, both hypo- and hyper-peritectic alloys are supposed to solidify with α-cells/dendrites which are then covered with a solid layer of β-phase when the temperature along the α-cells/dendrites drops below T_p. For an alloy with a concentration of $c_{p,l}$, the so-called hyper-peritectic limit, cellular/dendritic solidification of β is expected for growth velocities above the constitutional undercooling limit.

Close or below the limit of constitutional undercooling of both solid phases, directional solidified peritectic alloys show a variety of complex microstructures. Corresponding investigations were made for Zn–Ag [2], Sn– Cd [3–6], Cu-Sn [7], Pb–Bi [8–12], Zn–Cu [13–15], Sn–Sb [16,17], Ti–Al [18,19], Fe–Ni [20–30], Ni– Al [31], YBCO [32], Nd–Fe–B [33] and the organic model system TRIS–NPG [34–41]. The microstructures found are isothermal peritectic coupled growth (PCG), cellular peritectic coupled growth, discrete bands, island bands, and oscillatory tree-like