Prediction of the secondary arms spacing based on dendrite tip kinetics and cooling rate	
Authors	**Ibrahim Sari, Mahmoud Ahmadein, Sabbah Ataya, Lakhdar Hachani, Kader Zaidat, Nashmi Alrasheedi, Menghuai Wu, Abdellah Kharicha**
Publication Year	2024
Grant Number	IMSIU- RP211202
DOI link	10.3390/ma17040865

Abstract: Secondary dendrite arm spacing (SDAS) is one of the most important factors affecting macrosegregation and mechanical properties in solidification processes. Predicting SDAS is one of the major parameters in foundry technology. In order to predict the evolution of microstructures during the solidification process, we proposed a simple model which predicted the secondary dendrite arm spacing based solely on the tip velocity (related to the tip supersaturation) and cooling rate. The model consisted of a growing cylinder inside a liquid cylindrical envelope. Two important hypotheses were made: (1) Initially the cylinder radius was assumed to equal the dendrite tip radius and (2) the cylindrical envelope had a fixed radius in the order of the dendrite tip diffusion length. The numerical model was tested against experiments using various Pb–Sn alloys for a fixed temperature gradient. The results were found to be in excellent agreement with experimental measurements in terms of SDAS and dendrite tip velocity prediction. This simple model is naturally destined to be implemented as a sub-grid model in volume-averaging models to predict the local microstructure, which in turn directly controls the mushy zone permeability and macrosegregation phenomena.