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Note

EFFECT OF TERNARY ADDITION IN BINARY FACETED EUTECTICS

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Jackson and Hunt's classification [1] is well accepted for predicting the microstructure and growth behaviour of binary eutectics. Various papers [2—5] have been published on nonfaceted—nonfaceted and faceted—nonfaceted eutectics, and microstructures are compared with theoretically predicted microstructures. In faceted—faceted systems, especially when parent phases are compounds, crystal structures are complex and α-parameters cease to provide the satisfactory physical descriptions of the interface structure. Rastogi and co-workers [6—8] studied a series of organic eutectics which have normal (lamellar or rod) microstructures. They determined the diffusion coefficient to test whether the microstructures are truly lamellar or rod in the sense of Jackson and Hunt's classification. Microstructures of β-naphthol—catechol and α-naphthol—catechol eutectics are lamellar, as shown in Figs. 1 and 2. The present paper reports the preliminary results of the effects of ternary addition on the growth equation and microstructures of the above eutectics.

α-Naphthol was added in β-naphthol—catechol and naphthalene in the α-naphthol—catechol system. These impurities were chosen because they form simple ternary eutectics. The methods adopted for the studies were similar to those given in ref. 6.

Crystallization velocity data of ternary eutectics obeyed the equation

$$V = u''(\Delta T)^n \quad (1)$$

where u'' is constant depending on the same parameter u for binary eutectics [6] and also on the geometry of the parent components [2]. Values of u and n are given in Table 1. The values of n are close to 2, indicating a direct square relationship between velocity and supercooling for both binary and ternary eutectics. Details of the mechanism of crystallization for ternary eutectics are discussed elsewhere [8].

The microstructures of the ternary eutectics did not indicate direct resemblance with those of the constituent binary eutectics. The lamellar nature of the β-naphthol—catechol eutectic is completely replaced by the feather struc-

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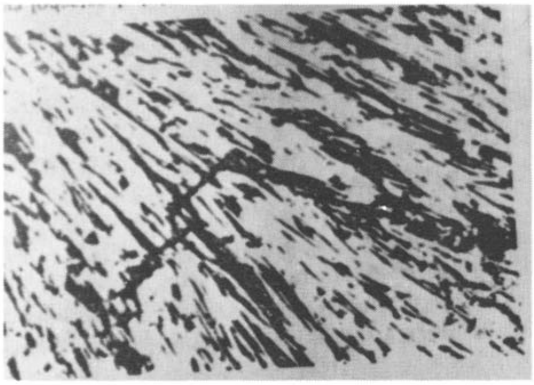
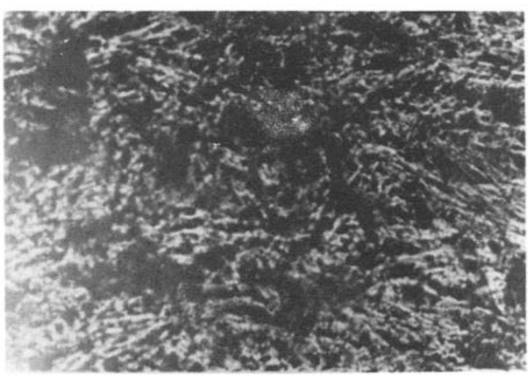


Fig. 1. Microstructure of the α-naphthol—catechol eutectic [6]. × 50.

Fig. 2. Microstructure of the β-naphthol—catechol eutectic [6]. × 50.

ture due to addition of naphthalene. The phases grow side by side away from the nucleation centre. The growth rate of naphthalene is very high compared with α-naphthol and catechol. Hence naphthalene grows rapidly, affecting the interface which completely changes to feather type. This transition from lamellar to feather structure justifies Chadwick's idea [9] of localized supercooling. The microstructure of the α-naphthol—β-naphthol—catechol eutectic is chinese-script. β-Naphthol and catechol grow side by side and α-naphthol is interspersed in such a way that the whole structure appears to be regular. Transition from lamellar to chinese-script is due to the constraints of non-unidirectional growth imposed upon the alloy during eutectic growth. The diffusion coefficient values for all binary systems formed by the constituent phases of the ternary eutectics are of the same order [7,8], so the transition from lamellar to feather or chinese-script depends on the nature of the impurity and the anisotropy of interfacial energy.



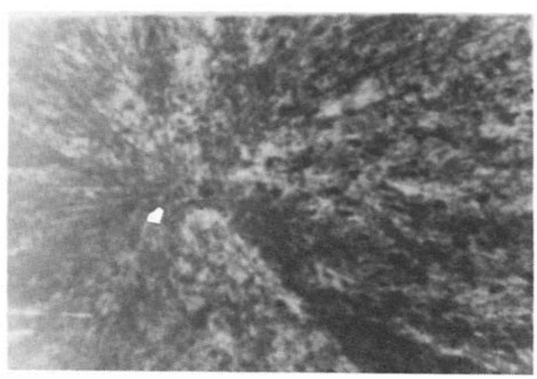


Fig. 3. Microstructure of the β-naphthol—catechol eutectic containing α-naphthol impurity. × 50.

Fig. 4. Microstructure of the α-naphthol—catechol eutectic containing naphthalene impurity. × 50.

TABLE 1

Values of u and n

System	u	n(cm sec^{-1} deg^{-2})
β-Naphthol—catechol eutectic	0.00084	1.79
α-Naphthol—catechol eutectic	0.00063	1.71
α-Naphthol—catechol eutectic containing naphthalene impurity	0.00033	1.75
β-Naphthol—catechol eutectic containing naphthol impurity	0.00166	1.82

There is no direct resemblence between the microstructures of binary and ternary eutectics.

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