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PII: S0001-8686(13)00118-8
DOI: doi: 10.1016/j.cis.2013.10.003
Reference: CIS 1318

To appear in: *Advances in Colloid and Interface Science*

Please cite this article as: Schwarzenberger Karin, Köllner Thomas, Linde Hartmut, Boeck Thomas, Odenbach Stefan, Eckert Kerstin, Pattern formation and mass transfer under stationary solutal Marangoni instability, *Advances in Colloid and Interface Science* (2013), doi: 10.1016/j.cis.2013.10.003

Pattern formation and mass transfer under stationary solutal Marangoni instability

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Abstract

According to the seminal theory of Sternling and Scriven [1] the solutal Marangoni convection during mass transfer of surface-active solutes may occur as either oscillatory or stationary mode. With strong support of Manuel G. Velarde, a combined initiative of experimental works, in particular to mention those of Linde, Wierschem and co-workers, and theory has enabled a classification of dominant wave types of the *oscillatory* mode and their interactions. In this way a rather comprehensive understanding of the nonlinear evolution of the oscillatory instability could be achieved. A comparably advanced state-of-the-art with respect to the *stationary* counterpart seemed to be out of reach a short time ago. Recent development on both the numerical and experimental side, in combination with assessing an extensive number of older experiments, now allow to draw a more unified picture. By reviewing these works, we show that three main building blocks exist during the nonlinear evolution: roll cells, relaxation oscillations and relaxation oscillations waves. What is frequently called *interfacial turbulence* results from the interaction between these partly coexisting basic patterns which additionally may occur in different hierarchy levels. The second focus of this review lies on the practical importance of such convection patterns concerning their in-

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