Bernard-Marangoni instability in the transparent conductive polymeric films containing MWCNTs

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We investigated the effect of Bernard-Marangoni(B-M) instability on the electrical conductivity of polymer/MWCNTs composite films. B-M instability occurs when the thermal Bernard-Marangoni number is higher than a critical number. We studied on three types of conditions; unstable, onset, and stable. The electrical conductivity of composite films are strongly affected by B-M instability. The expression of percolation scaling law is modified where the Bernard-Marangoni cell is taken into account. The modified percolation scaling law could be written as $\log(R_{s0}/R_s)=\log(c\beta-c^0)^t$. The value of β was found to be 1.0, 1.2, and 0.8 at stable, onset, and unstable condition, respectively. The exponent t was found to be 2.0, indicating the MWCNT/polymer composite films exhibit three-dimensional behavior in percolation scaling law despite that the B-M instability occurs. The percolation threshold for PC/MWCNT composite films at stable, onset, and unstable condition is 3.30×10-3, 2.75×10-3, and 5.15×10-3 vol.%, respectively.