

MAR14-2013-020004

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Thermodynamics meets information in copolymerization processes

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Copolymers are natural supports of information. This latter is contained in the sequence of monomeric units composing every copolymer. A well-known example is DNA in biology. At the molecular scale, the growth of a single copolymer is stochastic and proceeds by successive random attachments or detachments of monomers continuously supplied by the surrounding solution. The thermodynamics of copolymerization with or without a template shows that fundamental links exist between entropy production and the information content of the copolymer sequence [1,2]. During depolymerization, this information is erased in a way compatible with Landauer's principle [3]. These advances open new perspectives to understand information transmission during DNA replication and, more generally, information processing at the molecular scale in biology and polymer science.

[1] D. Andrieux and P. Gaspard, Nonequilibrium generation of information in copolymerization processes, Proc. Natl. Acad. Sci. USA 105, 9516 (2008).

[2] D. Andrieux and P. Gaspard, Molecular information processing in nonequilibrium copolymerizations, J. Chem. Phys. 130, 014901 (2009).

[3] D. Andrieux and P. Gaspard, Information erasure in copolymers, EPL 103, 30004 (2013).