Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

The Generality of Parallel Offsets of Rheological Response of Filled Elastomers SHOUBO LI, GUOCHUN ZHAN, YONGLI MI, Department of Chemistry, Tongji University, Shanghai, P. R. China, XIAORONG WANG, Institute for Advanced Study, Tongji University, Shanghai, P. R. China — We investigated the frequency and strain responses of oscillatory shear-induced nonlinearity for 14 filled rubber compounds. The elastomers used were poly(styrene-co-butadiene) or SBR rubber, poly(dimethylsiloxane) or silicone rubber, 1,4-cis polyisoprene or natural rubber, and poly(acrylonitrile-co-butadiene) or nitrile rubber. The fillers used were nano-sized carbon black, silica, clay, and calcium carbonate. Despite the wide differences in the polymer structure, chemical composition and the type of the filler as well as the shape, average size and the distribution of the particles, all systems display a universal feature that in both linear and nonlinear regimes the relationship between moduli and strain in response to the frequency change shows striking parallelism. This remarkable feature directly proclaims the existence of a new shear-rate frequency superposition for rubber materials. This superposition can be appropriately accomplished by first normalizing G' by $G'0$ and G'' by $G''0$, where $G'0$ and $G''0$ are the zero-strain limited value of G' and G'', then by horizontally shifting the curves of $G'/G'0$ and $G''/G''0$ along the frequency axis for each fixed shear-rate amplitude. This superposition principle involves neither model assumption nor parametric adjustment.

Xiaorong Wang
Institute for Advanced Study, Tongji University, Shanghai, P. R. China

Date submitted: 11 Nov 2014 Electronic form version 1.4