Supplemental Material

Relaxation Nuclear Magnetic Resonance Imaging
Investigation of Heterogeneous Aging in a Hydroxy-Terminated Polybutadiene Based Elastomer

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Figure 1S: The $^1$H NMR (a) spin-echo $T_2$ decay curve obtained from the bulk unaged HTPB/IPDI binder. All bulk $T_2$ relaxation experiments were obtained on a Bruker DRX400 at a $^1$H observed frequency of 400.1 MHz using a standard Hahn echo pulse sequence with 32 inter-pulse delays. Note that ~80% of the signal intensity decays within the first 2 ms. A (b) linear (natural log) plot of signal intensity versus echo delay time for the first 2.5 ms of decay. Note that for the unaged binder and this time regime the signal decay is described very well by a single exponential. A $T_2$ of 1289 µs (1.289 ms) was measured from a linear fit of this region.
**Figure 2S:** The $^1$H NMR (a) spin-echo $T_2$ decay curve obtained from the bulk aged HTPB/IPDI binder thermally oxidized at 8 days at 125 °C. All bulk $T_2$ relaxation experiments were obtained on a Bruker DRX400 at a $^1$H observed frequency of 400.1 MHz using a standard Hahn echo pulse sequence with 32 inter-pulse delays. This binder sample was finely cut (<500 µm cubes) to produce a high percentage of aged surface, versus unaged interior sample. A (b) linear (natural log) plot of signal intensity versus echo delay time for the first 2 ms of decay. Note that for the aged binder and this time regime the signal decay is described very well by a single exponential. A $T_2$ of 734 µs was measured from a linear fit of this region.

**Additional Discussion**

Ref. #7 provides a more detailed analysis of the $T_2$ relaxation in HTPB binder. These authors (D. Mowery, private communications) also observed multi-exponential decay profiles. In particular they observe an additional rapid decay of signal intensity during the first ~ 50 µs during $T_2$ experiments. Unfortunately this signal decay is not observable in our imaging studies due to the minimum acquisition delay of 60 µs ($t_p$) accessible in these imaging studies. This rapid decay does result in a significant portion of the signal intensity being lost. In addition, it also means that we are providing $T_2$ maps of the relaxation decay occurring using the 100 µs to 2 ms regime, which may reflect different spatial behavior than the very short relaxation component.