Electronic Supplementary Material (ESI) for RSC Advances.

SUPPORTING INFORMATION

for

Epoxidized Soybean Oil Cured with Tannic Acid toward Fully Bio-Based Epoxy Resin

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CONTENT

1 Isothermal curing kinetics

Isothermal TA-ESO curing kinetics were also investigated by monitoring the heat flow evolution during curing with TA Q200 DSC apparatus. The isothermal runs were performed at temperatures ranging from 140 to 200 °C for TA-ESO without H and from 80 to 140 °C for H-accelerated TA-ESO curing. The results of heat flow analysis of H0/TA and H1/TA composition were shown in Figure (a) and (c) below. The heat flow changes during isothermal reaction were recorded until no detectable deviation from the baseline was observed. The fractional conversion (%) at t, is given by the ratio of integrating the heat flow evolved within the polymerization time. The time to 80% conversion is displayed as a function of the inverse reaction temperature (1/T). This relationship corresponds to the following kinetic description [1,2]:

$$Int=K+(E\alpha/RT)$$

where K and R are both constant, the activation energy can be calculated from the slope in the diagram embedded in Figure (a) and (c).

For H0/TA, a broad exothermic peak was observed after 1 min of heating at 200 °C; and the isothermal peaks observed upon heating at 180 to 140 °C become even broader gradually. For H1/TA system, same phenomena could also be observed but the starting temperature was much lower, indicating the curing reaction of TA-ESO occurred at much lower temperatures due to the accelerating effect of H. It was useful to convert the obtained exothermic peaks to the fractional conversion, which provided an indication of the curing speed and used to calculate the activation energy, as non-isothermal curing did. As shown in Figure (b) and (d), Eα was calculated from slope of a linear fitting plot of $\ln(t_{80\%})$ to 1/K. For H0/TA23, Eα value was calculated as 56.5 $kJ.mol^{-1}$, which much higher than the calculated Eα value for the sample of H1/TA23 (48.0 $kJ.mol^{-1}$). These results suggested that the 2-substitued imidazole group in H could considerably improve the reactivity of curing reaction, which was in good agreement with the aforementioned non-isothermal results. According to the reviewer's suggestion, however, we have added this part as electronic supplementary information for the manuscript.

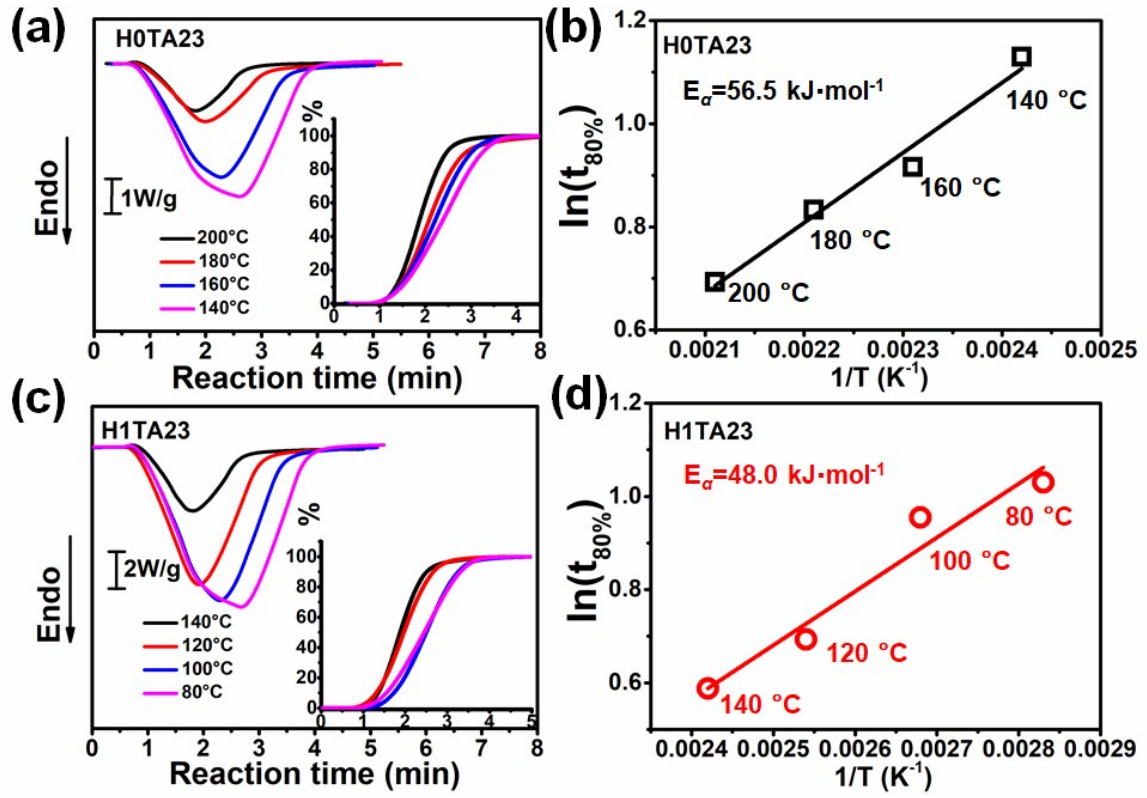

Figure S1. Isothermal curing kinetics study. (a) DSC isothermal scans of H0/TA23 at different temperatures (200, 180, 160, 140 °C). (b) DSC isothermal scans of H1/TA23 at different temperatures (140, 120, 100, 80 °C). (c) Linear plot of ln($t_{80\%}$) versus 1/T of H0TA23. (d) Linear plot of ln($t_{80\%}$) versus 1/T of H1TA23.

2 REFERENCE

1. R. Reisen. Thermosets, in Application Handbook Thermal Analysis. Mettler-Toledo GmbH 2006.
2. K. Lin, W. H. Heath and J. M. Torkelson. Kinetics of multifunctional thiol-epoxy click reactions studied by differential scanning calorimetry: Effects of catalysis and functionality. Polymer 2015, 81, 70-78.