Impact of Water and Oleic Acid on GMO Phase Transition and Bicontinuous Structure Formation in a White Mineral Oil

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Supporting Information

Small-angle X-ray scattering (SAXS) was used extensively in this study to determine the structures and phase transformations of glycerol monooleate (GMO) in white oil. Prior to testing the effects of the GMO, we first had to determine the scattering due to the air, white oil, and the capillary. These results can be seen in Figure S1. The results show no major structural features in the area of interest (Q ~ 0.1-0.4 Å^{-1}). These results were also used in the background subtraction procedures that were used before the SAXS patterns could be fit with the scattering models.

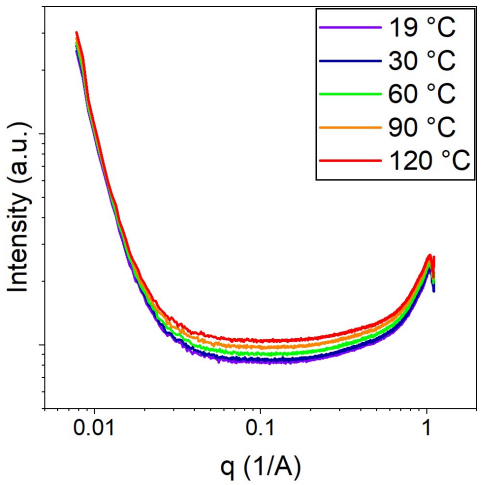

Fig. S1. Line scans for the pure white oil at various temperatures

SAXS of the GMO in white oil was performed at a wide range of compositions (Fig. S2). These results, along with the results shown in Fig. 1b and Fig. 1c were used to make the phase diagram that was shown in Figure 2b. SAXS data was collected approximately every 2 ℃ from 15 ℃ to 150 ℃ and then down to 25 ℃ again.

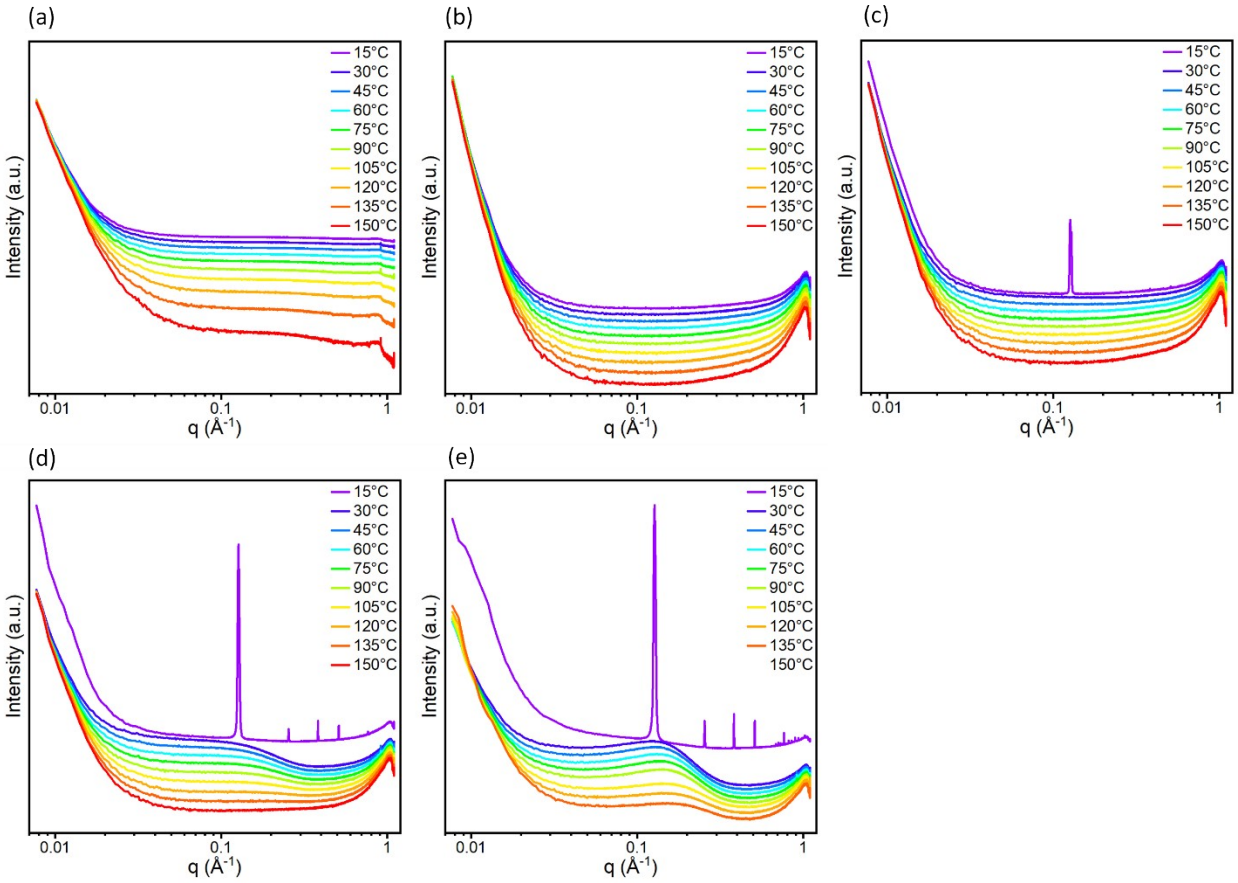

Fig. S2. SAXS data (without background subtraction) of the samples with a range of GMO concentrations in white oil collected at different temperatures during temperature ramp-up indicating different phase transition behaviors of (a) 0.01 wt.% GMO, (b) 0.05 wt.% GMO, (c) 1 wt.% GMO, (d) 10 wt.% GMO, and (e) 25 wt.% GMO. Linescans have been shifted vertically for clarity.

Similar SAXS data can be seen in Figs. S3-S5 for the 5 wt.% GMO in white oil samples with varying amounts of water and fatty acid concentrations. In all cases, the temperature was ramped from 15 ℃ to 175 ℃ and then back to 25 ℃. The data for the samples with varying concentrations of water can be seen in Fig. S3, which were used to create the phase diagram in Figure 4. For the samples with no water and varying concentrations of oleic acid, the data can be seen in Fig. S4. These data were used to create the phase diagram in Figure 6a. Lastly, the data with 1 wt.% water and varying concentrations of oleic acid can be seen in Fig. S5 and used to create the phase diagram in Figure 6b.

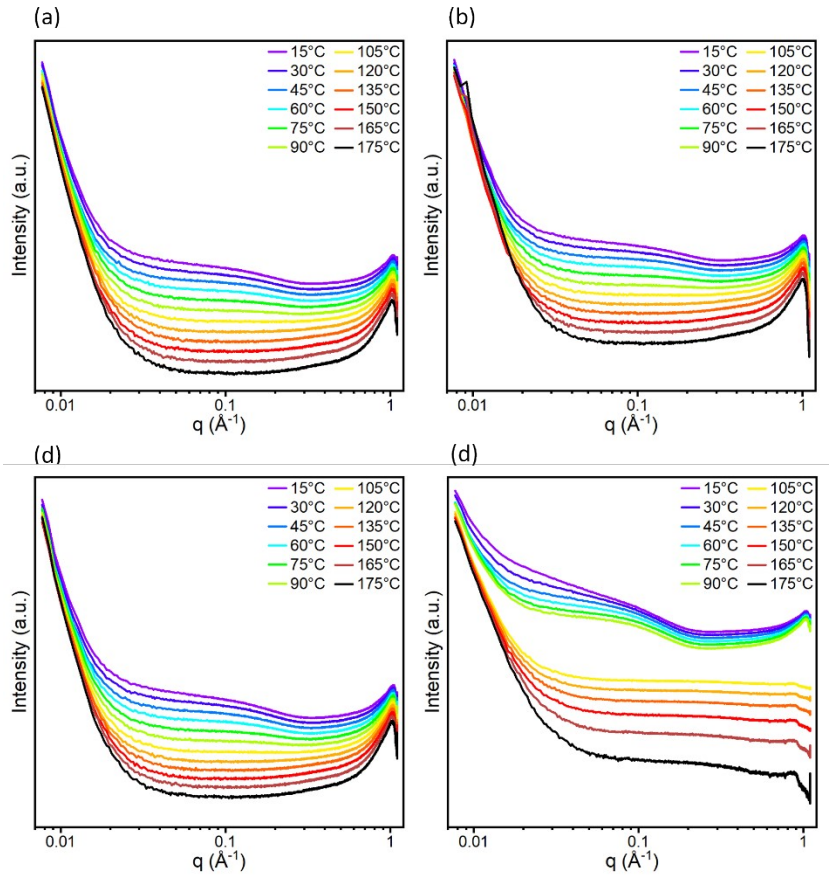

Fig. S3. SAXS data (without background subtraction) of the 5 wt.% GMO samples with a range of water concentration in white oil collected at different temperatures during temperature ramp-up indicating different phase transition behaviors of (a) 0.13 wt.% H_2O, (b) 0.19 wt.% H_2O, (c) 0.52 wt.% H_2O, and (d) 1 wt.% H_2O. Linescans have been shifted vertically for clarity.

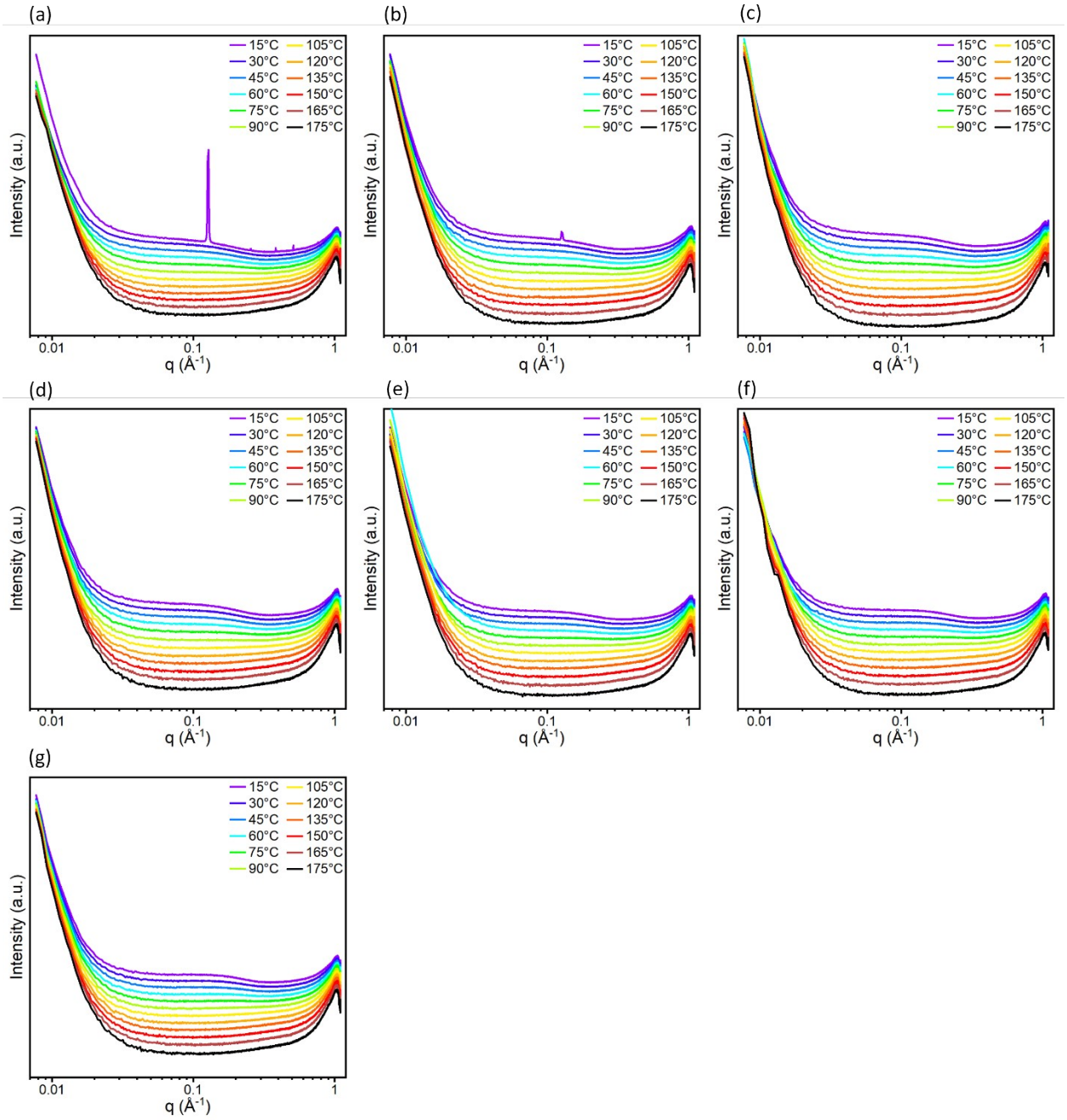

Fig. S4. SAXS data (without background subtraction) of the 5 wt.% GMO samples without water with a range of oleic acid concentration in white oil collected at different temperatures during temperature ramp-up indicating different phase transition behaviors of (a) 0.05 wt.% OA, (b) 0.16 wt.% OA, (c) 0.54 wt.% OA, (d) 1.15 wt.% OA, (e) 1.88 wt.% OA, (f) 3.56 wt.% OA, and (g) 5.09 wt.% OA. Linescans have been shifted vertically for clarity.

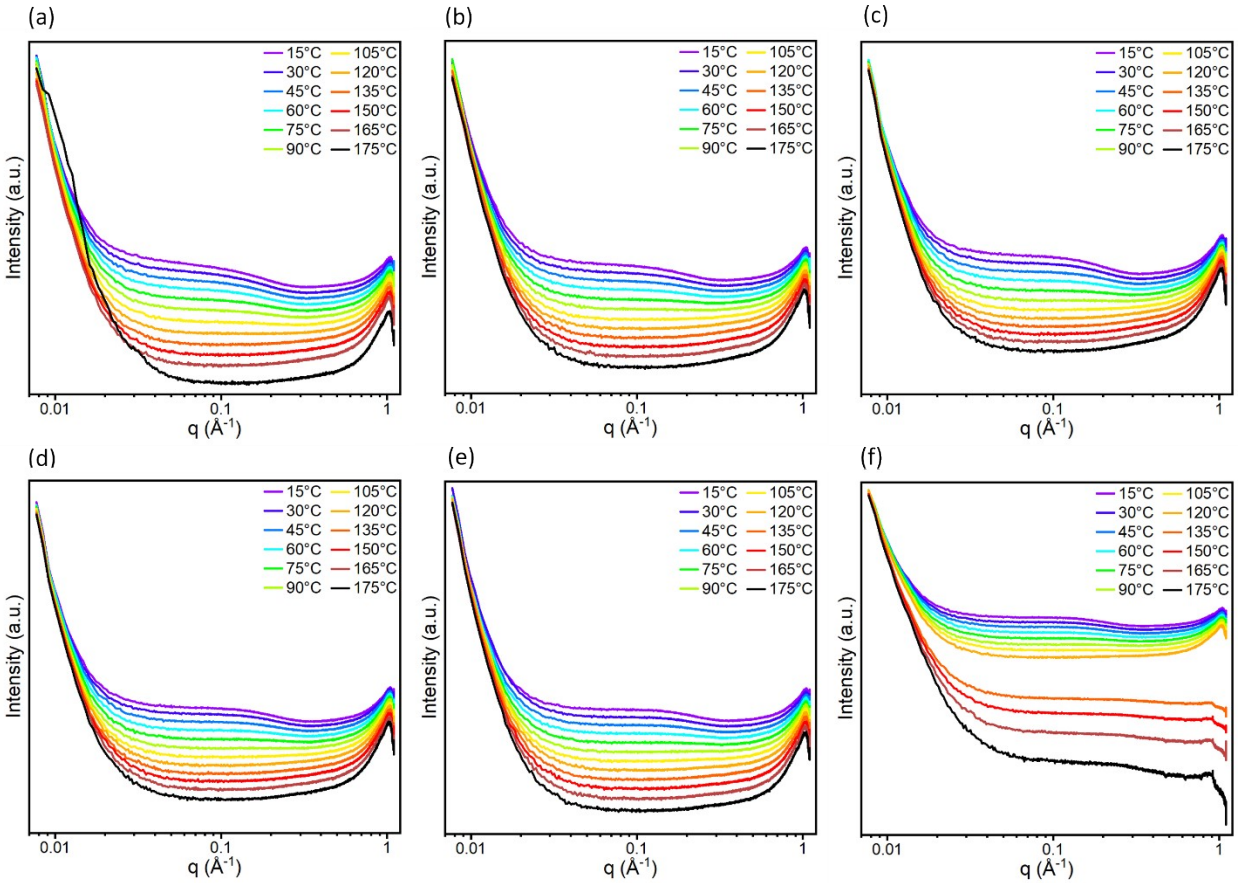

Fig. S5. SAXS data (without background subtraction) of the 5 wt.% GMO and 1 wt.% water samples with a range of oleic acid concentration in white oil collected at different temperatures during temperature ramp-up indicating different phase transition behaviors of (a) 0.2 wt.% OA, (b) 0.42 wt.% OA, (c) 1.36 wt.% OA, (d) 1.69 wt.% OA, (e) 3.4 wt.% OA, and (g) 4.88 wt.% OA. Linescans have been shifted vertically for clarity.