Electronic Supplementary Material (ESI) for RSC Advances.

Effect of Nb doping in WO_3/ZrO_2 catalysts on gas phase dehydration of glycerol to form acrolein

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Supporting Information

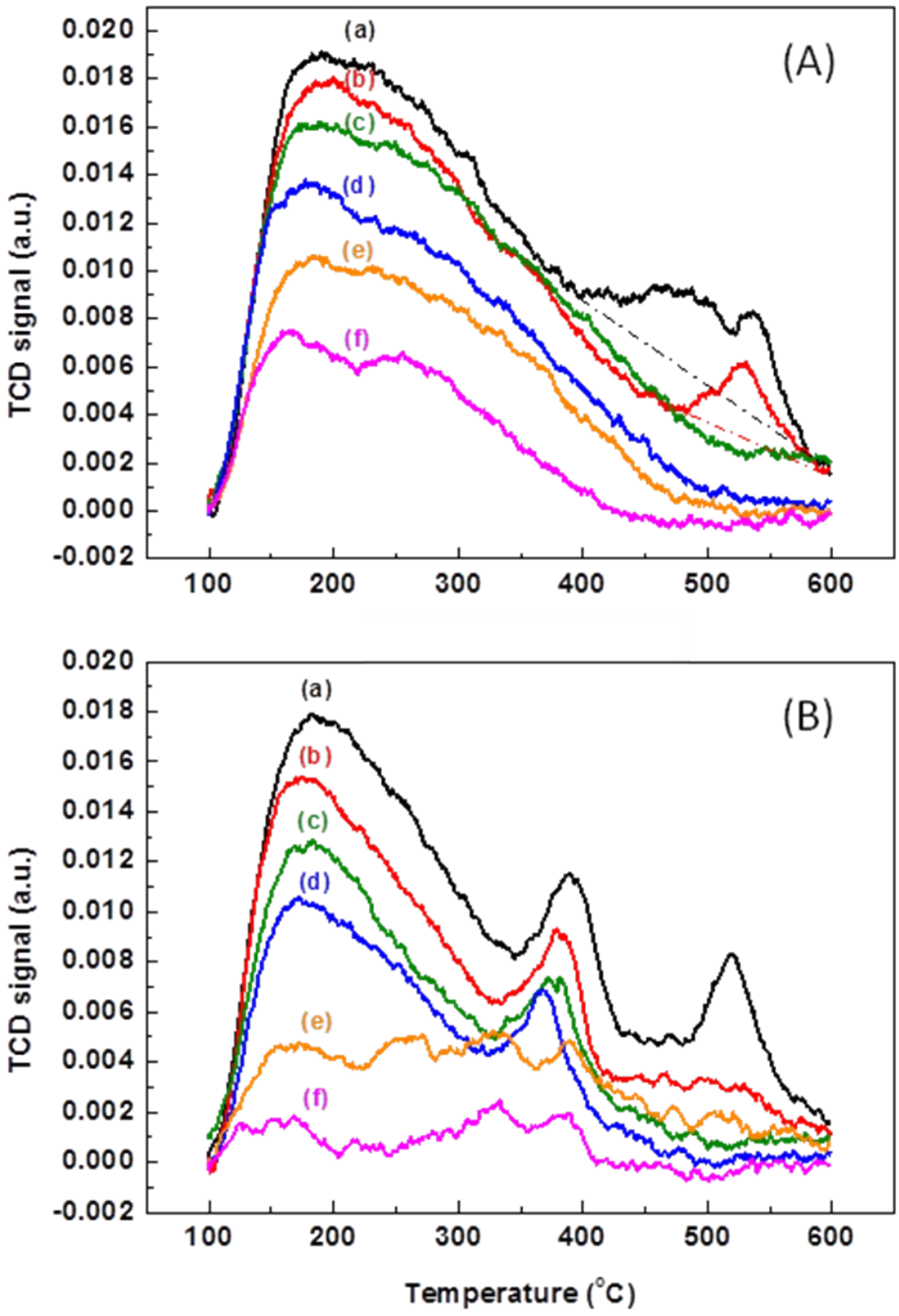


Fig. S1 (A) NH_3- and (B) CO_2-TPD thermograms of WO_3/ZrO_2 catalysts calcined at: (a) 400, (b) 450, (c) 500, (d) 600, (e) 700 and (f) 800ºC.

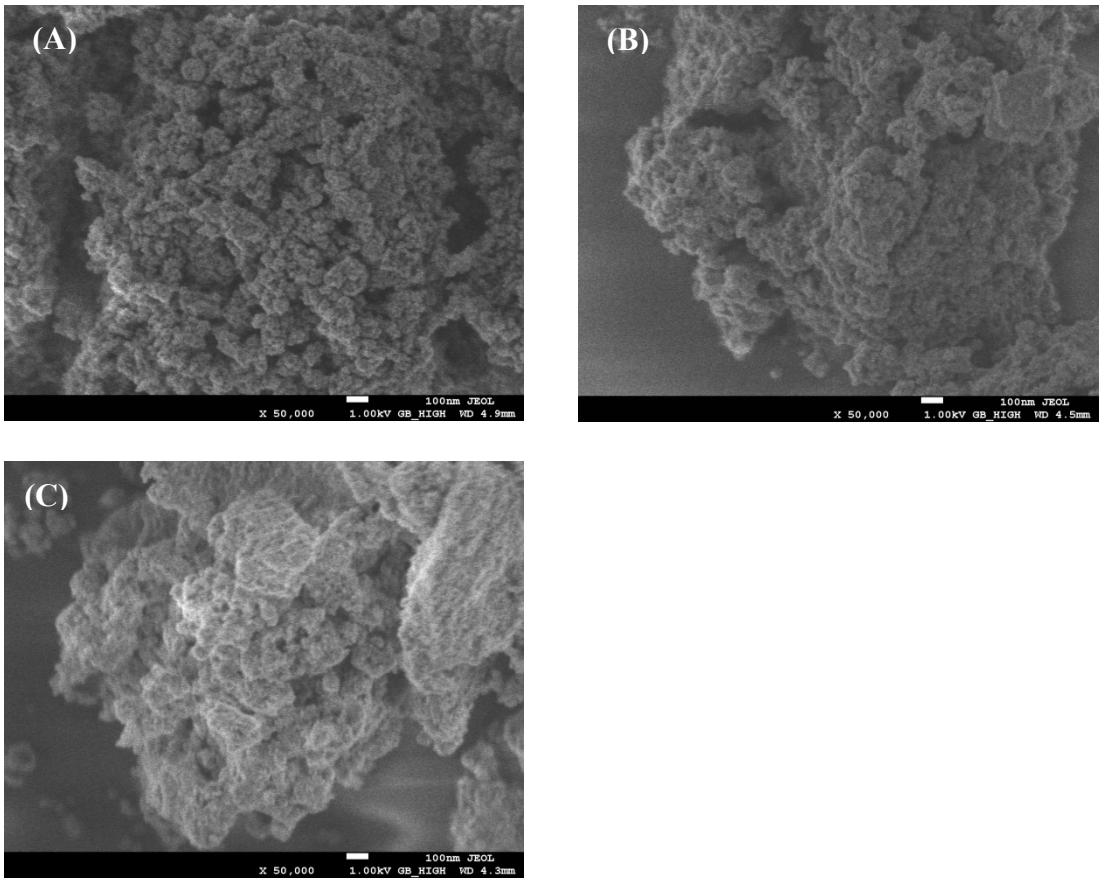


Fig. S2 The SEM photographs of (A) WO_3/ZrO_2-450 (B) 1%$NbWO_x/ZrO_2$-450 and (C) 3%$NbWO_x/ZrO_2$-450.

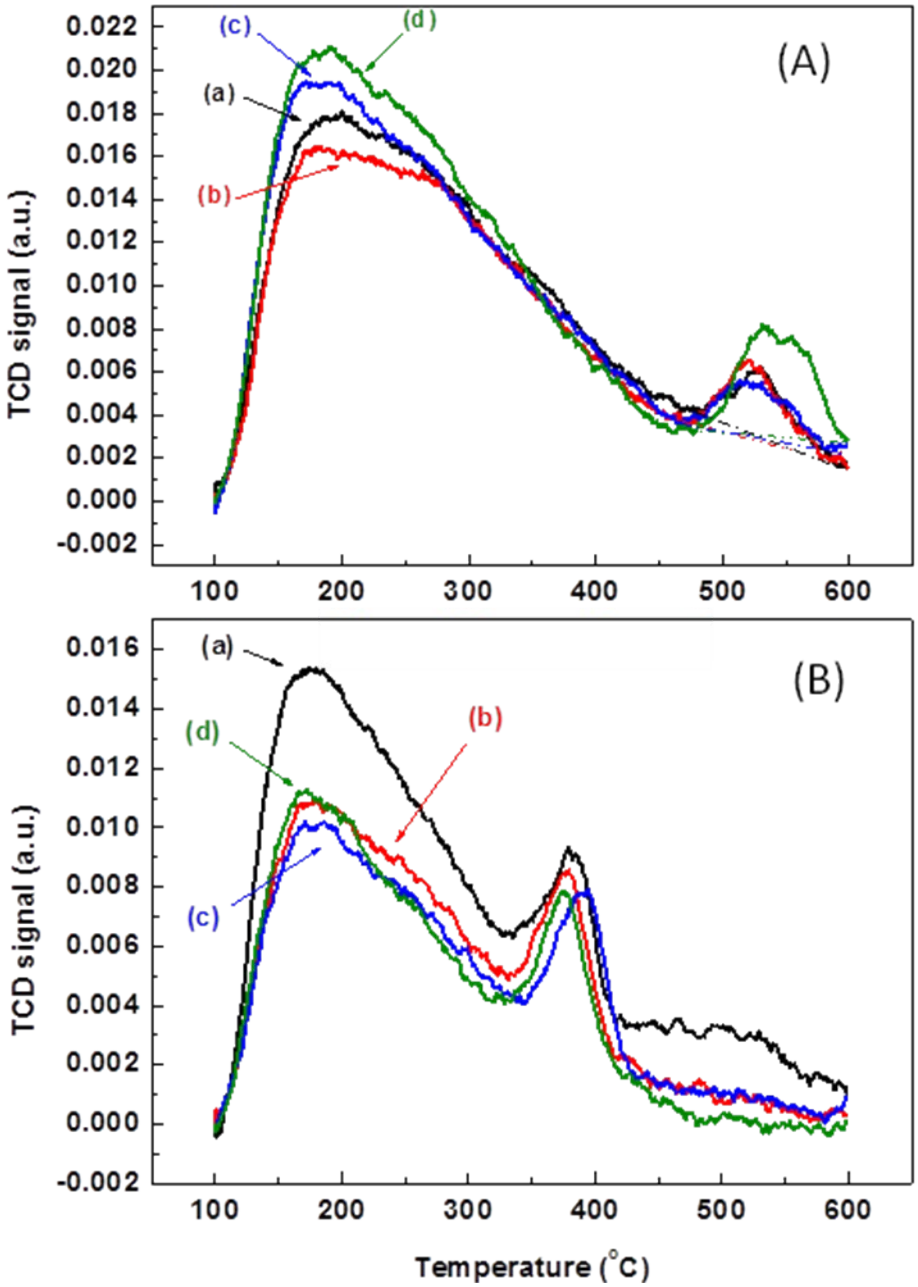


Fig. S3 (A) NH_3- and (B) CO_2-TPD thermograms of (a) WO_3/ZrO_2-450, and those doped with (b) 1% Nb_2O_5, (c) 3% Nb_2O_5, and (d) 5% Nb_2O_5.

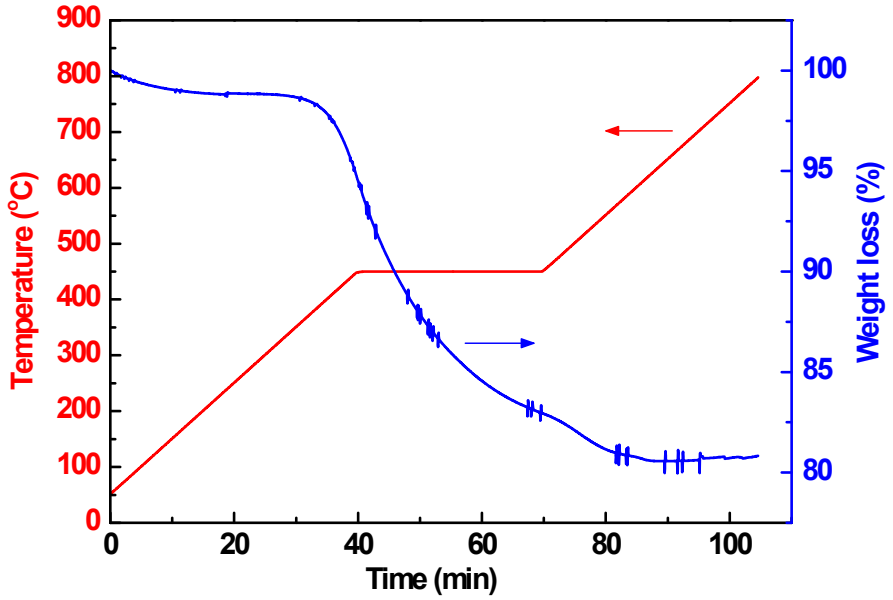


Fig. S4 Thermogravimetric analysis of 3%$NbWO_x/ZrO_2$-450 under air after catalytic reaction.

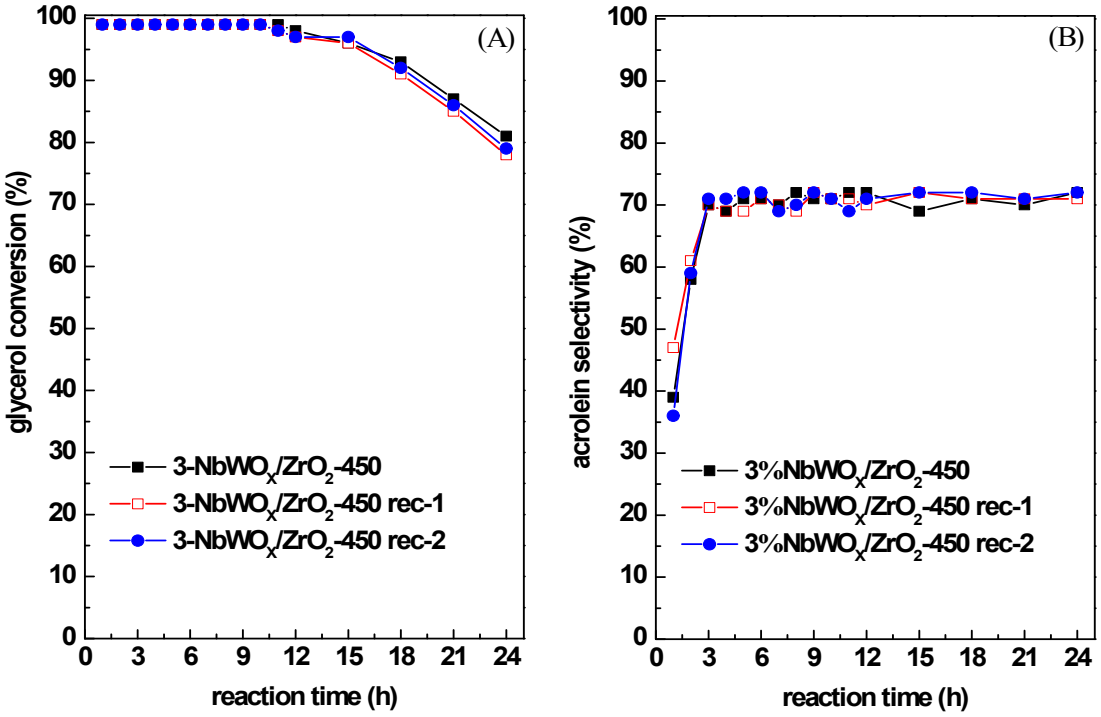
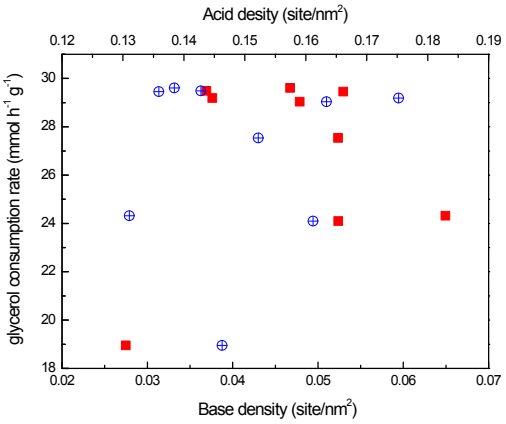
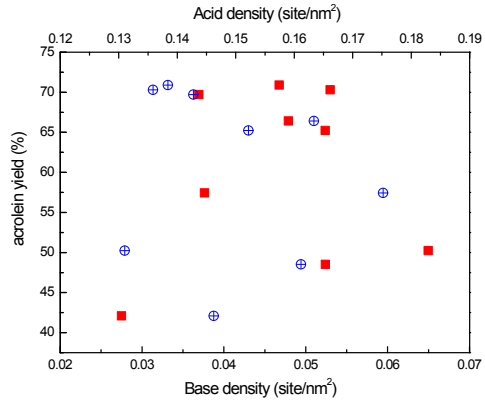


Fig. S5 Evolution of (A) glycerol conversion and (B) selectivity to acrolein versus TOS at 290ºC over fresh and regenerated 3%NbWO$_x$/ZrO$_2$-450 catalyst. 0.3 g catalyst, GHSV = 1117 h^{-1}, 60 mL/min N_2 flow rate.





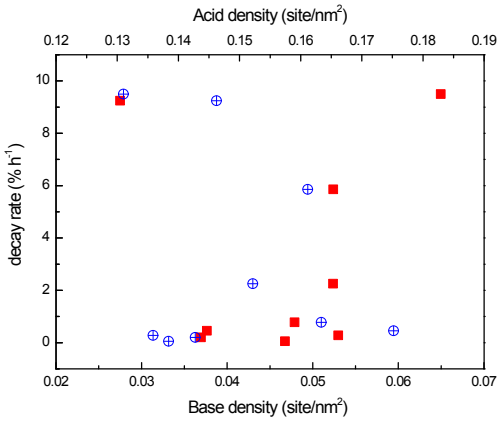


Fig. S6 Correlations of (A) specific glycerol consumption rates (average in 3–12 h TOS), (B) acrolein yield, and (C) decay rate with acid (■) and base (⊕) densities on

WO_3/ZrO_2 calcined at different temperatures and WO_x/ZrO_2-450 doped with 1－5% Nb_2O_5.