Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Ferroelectric based catalysis: Switchable surface chemistry[1]
ARVIN KAKEKHANI, SOHRAB ISMAIL-BEIGI, Yale University — We describe a new class of catalysts that uses an epitaxial monolayer of a transition metal oxide on a ferroelectric substrate. The ferroelectric polarization switches the surface chemistry between strongly adsorptive and strongly desorptive regimes, circumventing difficulties encountered on non-switchable catalytic surfaces where the Sabatier principle dictates a moderate surface-molecule interaction strength. This method is general and can, in principle, be applied to many reactions, and for each case the choice of the transition oxide monolayer can be optimized. Here, as a specific example, we show how simultaneous NO_x direct decomposition (into N_2 and O_2) and CO oxidation can be achieved efficiently on CrO_2 terminated $PbTiO_3$, while circumventing oxygen (and sulfur) poisoning issues. One should note that NO_x direct decomposition has been an open challenge in automotive emission control industry. Our method can expand the range of catalytically active elements to those which are not conventionally considered for catalysis and which are more economical, e.g., Cr (for NO_x direct decomposition and CO oxidation) instead of canonical precious metal catalysts.

[1]Primary support from Toyota Motor Engineering and Manufacturing, North America, Inc.

Arvin Kakekhani
Yale University

Date submitted: 14 Nov 2014 Electronic form version 1.4