The temperature-dependence of the reaction was evaluated using the saturated catalytic rate ($v_{\text{max}}$) in the range of 268-293 K (Figure 2). The Arrhenius plot showed a strong linear correlation with an apparent activation energy of 45.5 kJ/mol. Apparent activation energies at lower oxygen concentrations were similar. This value (45.5 kJ/mol) is slightly higher than most reported activation energies for CO oxidation ($\approx$ 30 kJ/mol) [4]. These differences are likely attributable to the measurements at higher conversions measuring additional changes with temperature beyond the intrinsic activities (e.g. local catalyst heating).

**Figure 1. CO Oxidation O$_2$ Dependence**

**Figure 2. Temperature-dependence of rate**

Using the kinetic characterization of the WGC catalyst as a baseline, we compare and contrast this system to dendrimer templated supported nanoparticle catalysts with the goal of providing a kinetic description of each system’s active site with respect to the reference catalyst. Because the dendrimer templated nanoparticles are deposited with surface thiols, appropriate pretreatment conditions are crucial for activating these catalysts. The optimum activation treatment consisted of N$_2$/H$_2$ flow at 523 K for sixteen hours to remove the thiols, followed by the WGC treatment protocol.

These two catalysts, although prepared by substantially different routes, show very comparable activities. Since the dendrimer templated nanoparticles are prepared through known and reproducible syntheses, this method and analysis has the potential to provide a reliable basis for the kinetic characterization of gold catalysis which Bond, Thompson, and Lewis report has been missing until now [4]. Additionally, the preparation route used for the dendrimer templated nanoparticles may shed some light onto the polarized debate regarding the nature of the active site (Au$^+$ vs. Au$^{2+}$). This kinetic characterization is also extended to bimetallic Au-Ni and Au-Co nanoparticles to evaluate the effects of incorporating heterometals into Au nanoparticles.

**Significance**

Our work is directed towards developing a kinetic characterization and better understanding of the CO oxidation active sites in gold catalysts. We provide a kinetic characterization of the active sites of catalysts prepared via vastly different methodologies, and can extend this characterization to evaluate the effects of heterometal incorporation.

**References**