# AEROGELS IN CATALYSIS

Aerogels can be used as catalysts or catalyst supports. TAASI offers flexibility of design of Aerogel catalysts at competitive prices.

## EXAMPLE APPLICATIONS:

| Aerogel Type | Aerogel Properties | Catalysis System | Remarks |
|---|---|---|---|
| $TiO_2$ | S = 120-600 $m^2/g$,<br>V= 0.5-1.8 cc/g,<br>d = 0.1-0.8 g/cc | Ambient Temperature photocatalysis:<br>Oxidation of salicylic acid;<br>Partial oxidation of paraffins, alcohols & olefins | Dagan & Tomkiewicz, 1993/94;<br>Teichner et al, 1972 |
| $TiO_2$-$SiO_2$ | S = 550-770 $m^2/g$,<br>V=1.7-2.05 cc/g,<br>d = 0.27-0.6 g/cc | Ambient temperature photocatalysis; oxidation of cyanides & benzene in water; conversion of gases and vapors in air | Attia & Ahmed; TAASI, 1993.<br>Attia, Patent 2000. |
| $Fe_2O_3$-$Cr_2O_3$-$Al_2O_3$ ,<br>$Fe_2O_3$-NiO-$Al_2O_3$,<br>$Fe_2O_3$-MgO, $Fe_2O_3$-$Al_2O_3$,<br>$Cr_2O_3$-$Al_2O_3$ | S = 265-700 $m^2/g$ | Selective Catalytic Reduction of NO by ammonia, 400-620 K (127-347 C) | Stability was excellent after heat pretreatment of aerogel; Willey et al, 1988. |
| $Al_2O_3$ -$SiO_2$ | S = 165-522 $m^2/g$,<br>V =0.37-1.68 cc/g | 1-Butene isomerization, 383-423 K | Thermal stability of aerogel discussed, Monaco & Ko, 1998. |
| CuO- $SiO_2$ (Cu = 3%)<br>$V_2O_5$- $SiO_2$ (V= 4%) | S = 565-590 $m^2/g$, V=1.1 cc/g;<br>S = 460-530 $m^2/g$, V=1.0-1.1 cc/g | Auto exhaust,<br>30-500 C, propane, propylene, CO, $NO_x$, $CO_2$, $O_2$, $H_2O$. | Surface area decrease: Cu-aerogel: 590 to 565 m2/g; V-aerogel: 530 to 460 m2/g.. Hair et al 1995. |
| $V_2O_5$- $TiO_2$<br>$WO_3$- $V_2O_5$- $TiO_2$<br>$CeO_2$- $V_2O_5$- $TiO_2$ | S = 51-115 $m^2/g$ | SCR of $NO_x$ by ammonia, 423-723 K (150-450 C) | 83-95% conversion, Willey et al, 1995. |
| $ZrO_2$, ZnO- $ZrO_2$<br>CuO- $ZrO_2$,<br>CuO- ZnO- $ZrO_2$ | S = 150-220 $m^2/g$ | Methanol synthesis from $CO/CO_2$ + $H_2O$ | Teichner et at, 1994. |
| MgO- $Fe_2O_3$ | S = 20-150 $m^2/g$ | SCR of $NO_x$ by ammonia, 423-723 K (150-450 C) | Willey et al, 1994 |
| Pd- $Al_2O_3$<br>Pd- $Ce_2O_3$- $Al_2O_3$<br>Pd-$La_2O_3$- $Al_2O_3$<br>Pd-BaO- $Al_2O_3$ | | Automotive CO oxidation by $O_2$ or NO | Thermal stability: heat aerogel for 4 hr. with $O_2$and $H_2O$ at 1000 C; S diminished, but catalytic activity was good, Pommier et al, 1991. |
| Ni- $Al_2O_3$ ($H_2$ reduction of NiO) | S = 160-650 $m^2/g$<br>V = 0.3-1.4 cc/g ($N_2$), 7.2-18.1 cc/g (Hg) | Dealkylation of ethylbenzene into benzene | Teichner et al, 1976 |
| Cu- $Al_2O_3$ ($H_2$ reduction of CuO) | S = 662 $m^2/g$ | 100% selectivity in partial hydrogenation of acetylene into ethylene, & cyclopentadiene into cyclopentene | Teichner et al, 1978/79 |
| NiO- $Al_2O_3$<br>NiO-$SiO_2$- $Al_2O_3$ | | Partial oxidation of olefins with NO: isobutene to methacroleine & acetone; n-propane to acetone; olefins, paraffins & alkylaromatic to nitriles (plastics) | Teichner et al, 1976 |
| $Fe_2O_3$-$Al_2O_3$<br>$Fe_2O_3$--$SiO_2$ | S = 800 $m^2/g$ | Fischer - Tropsch synthesis: hydrogenation of CO to hydrocarbon fuels (gasoline, diesel, etc.) | Teichner et al, 1983/84 |
| PbO- $Al_2O_3$ | | Conversion of Xylene isomers into nitriles | Teichner & Pajonk, 1985. |