

### MEASURING VOLATILE/SOLID CARBON BRANCHING RATIOS FOR FISCHER-TROPSCH-TYPE REACTIONS.

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**Introduction:** CO and hydrogen are two of the most abundant molecules in any protostellar nebula, and additional CO is generated as carbonaceous interstellar grains and grain coatings fall into the hotter regions and become oxidized. At the same time copious quantities of interstellar silicate dust as well as grains newly condensed following energetic events in such nebulae (e.g., lightning, shocks or large-scale collisions) provide surfaces on which CO and hydrogen can interact. This is the perfect environment for Fischer-Tropsch type (FTT) reactions to occur.

Comprehensive reviews [1] of Fischer-Tropsch Type (FTT) reactive synthesis on active grain catalysts that may have been present in the primitive solar nebula are available in the literature, as are reports of more recent work on this topic [2-6]. We have found that FTT reactions are quite different from what had been assumed in much of this past work. In particular, we find that as grain surfaces become coated with carbonaceous material, not only do such surfaces remain catalytically active, but in many instances the coating is a better FTT catalyst than the original grain surface [7] as measured by the rate at which it facilitates destruction of CO or generation of CH<sub>4</sub>.

**Importance of the Volatile/Solid Branching Ratio:** Earlier studies of FTT reactions assumed that all CO was converted to CH<sub>4</sub> and that a carbonaceous coating would poison catalytic surfaces and stop such reactions. Little consideration was given as to how CH<sub>4</sub> might be incorporated into planetesimals. However, not only will a carbonaceous coating provide increased catalytic area to promote FTT reactions, but the carbonaceous coating itself is easy to incorporate into meteorite parent bodies as nebular dust accretes.

In order to model the carbon cycle in protostellar systems it will therefore be necessary to understand not only the rate of CH<sub>4</sub> production from CO, but also the rate at which a solid carbonaceous coating can be expected to form on major grain types. For some grain types such as Mg-silicates, the coating is several orders of magnitude more efficient at catalyzing the destruction of CO than the original silicate surface: coating such grains greatly increases the FTT reaction rate while generating CH<sub>4</sub> does not.

We have recently developed the capability to quantitatively monitor gas phase species over FTT catalysts and can therefore derive the ratio of carbon incorporated into grain coatings compared to carbon going into CH<sub>4</sub>, CO<sub>2</sub> or C<sub>2</sub>H<sub>6</sub> (the most common reaction products observed in our system). ***We will present data on the ratio of volatile/solid carbon produced over several different catalysts as a function of time and temperature.***

**References:** [1] Hayatsu, R.; Anders, E.V. *Top. Curr. Chem.* 1981, 99, 1–37. [2] Fegley B. and Hong Y. (1998) *EOS Trans. AGU*, 79, S361. [3] Fegley, B. (1999) *Space Sci. Rev.* 90, 239 – 252. [4] Kress, M. E. and Tielens, A. G. G. M. (2001) *MAPS* 36, 75 – 91 [4] Hsu W. et al. 1997. 28th LPSC pp. 609–610. [5] Ferrante, R. F., Moore, M. H., Nuth, J. A. and Smith, T. (2000) *Icarus* 145, 297–300. [6] Hill. H. G. M. and Nuth, J. A. (2003) *Astrobiology* 3, 291 – 304. [7] Nuth J.A., Johnson, N.M. and Manning, S., 2008a *Ap. J. (Lett.)* 673 L225 - L228.