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**ABSTRACT**

Our goal is to understand the physical and chemical processes responsible for new particle formation in the atmosphere. Nucleated particles grow to sizes that serve as seeds for cloud droplet formation (50-100 nm). New particle formation is an important process for climate modelers because of its effects on cloud cover, which influences albedo. Our strategy involves developing instruments that can measure the trace concentrations (typical mole fractions $10^{-11}$ to $10^{-12}$) of species in the atmosphere that participate in nucleation and growth, and to develop models that are consistent with those measurements.

**Acid-Base Reaction Nucleation Model**

SIMPLE CONCEPTUAL MODEL FOR CHEMICAL NUCLEATION BASED ON OBSERVATIONS SHOWN IN FIGURES TO THE LEFT

- Dimer ($A_2$), Trimer ($A_3$), Tetramer ($A_4$) contain two, three, and four $H_2SO_4$ molecules plus other compounds (water, ammonia, amines, etc.) that cannot be detected with the cluster CIMS.
- Conceptual model treats nucleation as a series of chemical reactions between acidic and basic compounds.
- Reaction of More Volatile Dimer (MV) with a basic gaseous compound produces a Less Volatile dimer (LV).
- Tetramer ($A_4$) is the smallest stable cluster. Therefore, $J=A_4$.
- Model does not yet take into account possible dependencies on temperature and relative humidity.

**Prototype Instruments for Nucleation Research**

Developed by Members of Our Research Team

Particle number distributions down to 1 nm

McMurry group

Jingkung Jiang, Modi Chen


**Number Distributions Down to One Molecule**

From Chamber Experiments at U. Minnesota

Measured; t=time after lights were turned on

Titcombe, PhD Thesis; Chen et al, PNAS, 2012

**Acid-Base Chemical Reaction Model Agrees with Direct Observations of Nucleation Rates to within about 10X**

Chen et al, PNAS, 2012

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