Title: Solar Photodegradation of Metoprolol in Simulated Natural Water Samples

Author(s):

Heidi Sabatini\*, Wendy C. Cory

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\*Gamma Delta, 2019

Abstract/Description:

As pharmaceutical contamination in our waterways increases, there is an urgent need to understand the behavior of pharmaceutically active compounds (PhACs) and their solar photodegradation products in the aquatic environment. Determining the rate of solar photodegradation and any potential transformation products in natural water samples is an important step in assessing the risk that pharmaceuticals pose to human and environmental health. In this research, metoprolol (MTP), a common blood pressure medicine, was investigated as a potential pharmaceutical pollutant. In order to study its solar photodegradation, samples were prepared in a dilute aqueous buffer solution (pH=7.0) to mimic realistic environmental conditions. Dissolved organic matter known as humic acid (HA) was added to investigate the possibility of indirect photodegradation. The solutions were photoexposed using a solar simulator to mimic natural sunlight and then analyzed using High Performance Liquid Chromatography (HPLC) to determine the rate of solar photodegradation. Results indicate that increasing concentration of HA caused an increase in the rate of degradation of MTP. Transformation products were observed using a Liquid Chromatography - Mass Spectrometer (LC-MS) and tandem MS was used to propose structures for these products.

Title:

Pandemic Epidemiology: Interim Analysis of a COVID-19 Healthcare Worker Serosurvey

Author(s):

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\*Alpha Theta, 1998

Abstract/Description:

An interim analysis of a pragmatic cohort study among healthcare workers at a university-associated, tertiary-care hospital system in a rural state during the ongoing COVID19 pandemic. Data collection occurred from August 2020 – May 2022.

Title:

Predicting the Magnetic Dynamo Development of Super-Earth Exoplanets

Author(s):

Nathaniel White

Abstract/Description:

Given a planet with a known mass and radius, how likely is it to be habitable? Using a variety of computational methods, this is the question that we attempt to answer, from a variety of angles, within this paper. Various algorithms and a Rose-Vinet equation of state are used to approximate the internal structure of a terrestrial super-earth exoplanet of a given mass and radius. These models are then used to estimate the thermodynamic properties, internal bulk composition, and core radius of a variety of likely-terrestrial exoplanets. When considered alongside existing planetary data, these calculations have implications for the development and sustainability of a magnetic dynamo on each exoplanet. Other findings include the adjustment of the mass-radius parameters of certain planets and the identification of a bulk composition that would result in a maximum thermal energy contribution during differentiation.

Title:

Carbon dissolution via beam reflectivity measurements on nickel single crystal catalysts

Author(s):

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\*Alpha Kappa - 2011

Abstract/Description:

Carbon atom diffusion on the surface and into the bulk of metal particles can modulate

catalytic reactivity and film growth. Subsurface carbon diffusion is a primary step in graphene,

carbon nanotube (CNT) and carbon nanofiber (CNF) growth on Ni substrates via chemical vapor

deposition (CVD). Carbon build-up in the subsurface of nickel steam reforming catalysts gradually

reduces catalytic activity and ultimately deactivates the metal catalyst. Traditionally, carbon

diffusion is monitored using post-dose spectroscopic techniques. These methods require long wait

times, temperature changes during the measurement, and correction and fitting of the spectroscopic

peaks. Here, we use a novel molecular beam reflectivity approach to measure carbon diffusion and

site-blocking kinetics in real time quantified on a flat Ni(111) and stepped Ni(997) surfaces. We

track carbon uptake onto and into the Ni single crystal while holding surface temperature constant

throughout the measurement. This new application of molecular beams allows for real-time,

surface-sensitive detection of carbon dissolution into the crystal bulk at the elevated temperatures

used in steam reforming (650 – 1000 K). The onset of carbon dissolution occurs over a relatively

narrow temperature range. Diffusion was found to be well fit by a Fickian model and we report a

bulk diffusion barrier, ED, of 151 ± 16 kJ mol-1 and 124 ± 39 kJ mol-1 for Ni(111) and Ni(997), respectively. We are also able to use the diffusion model to trace carbon and probe coverage

dependent reaction trends at these elevated temperatures.

Title:

Characterization of Myocilin Disease Mutants

Author(s):

Kenneth Liu, Hailee Scelsi

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Abstract/Description:

Mutations of myocilin are causative for 10-33% of juvenile open angle glaucoma cases,

a leading cause of pediatric blindness. Known disease mutations are primarily found in the

C-terminal olfactomedin domain (OLF) of myocilin and are highly destabilizing. While some of

the more mild disease mutants have been recombinantly expressed and characterized in E. coli,

the most severe mutations have resisted all attempts at purification. Using an algorithm

designed to enhance recombinant protein folding in E. coli, we designed a highly stable mutated

OLF scaffold. Borrowing ideas from protein engineering, we have inserted the most destabilizing

disease mutations into the more stable OLF scaffold. We have successfully expressed and

characterized these mutants in the engineered OLF. Our results show promise in allowing us to

shed light on the structural and biophysical factors that may play a role in glaucoma

pathogenesis.