Post-Doctoral Positions - Rice University

Using Hydrocarbons to make Advanced Materials and Clean Hydrogen without CO₂ emissions

We have two post-doctoral openings in the team of Profs. Matteo Pasquali and Glen Irvin at Rice University's Chemical and Biomolecular Engineering Dept. We are facing multiple, intertwined challenges as we develop solutions for:

- emission-free sources of clean hydrogen for energy
- lightweighting and electrification of our transportation systems
- decarbonization of industrial sector, by ↓ emissions from metal and cement production.

High-efficiency, direct conversion of methane into useful advanced carbon nanomaterials (i.e. carbon nanotubes) and clean hydrogen can give a way to advance all these goals. CNTs can be converted into macroscopic materials (fibers, films, and foams) with properties competitive or superior to CO₂-intensive materials (steel, aluminum, construction materials). Fundamental advances are needed in catalysis, reaction engineering, and solution processing to attain the efficiencies needed to have positive Hydrogen (energy) production at large scale.

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<th>OPEN POSTDOCTORAL POSITIONS AT RICE UNIVERSITY</th>
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<td>(1 Yr with Renewal Option - Applications received by Dec 1, '19 given full consideration)</td>
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<tr>
<td><strong>CNT Synthesis and Reaction Engineering</strong></td>
<td><strong>CNT Fiber Spinning and Processing</strong></td>
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<td>Focused on understanding/improving concurrent production of hydrogen and CNTs via thermocatalytic pyrolysis/chemical vapor deposition.</td>
<td>Focused on understanding/improving solution spinning of CNT fibers and their mechanical, electrical, and thermal properties</td>
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<td>LEAD advances in: reactor design, catalyst development and utilization, process engineering, and reaction engineering.</td>
<td>LEAD advances in: soft condensed matter and rheology of CNT phases, coupled transport and thermodynamics in solvent/nonsolvent systems, structure-processing-properties relationships in CNT materials, process integration, and recyclability.</td>
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<td>Skills: reactor operation and design, aerosol dynamics, hydrocarbon pyrolysis, microscopy, reaction engineering, gas phase reactions.</td>
<td>Skills: microscopy, colloidal science, rheology, soft condensed matter physics, and transport in complex liquids/ fluids.</td>
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This effort is funded by a recent ARPA-E grant and industrial collaborations (https://news.rice.edu/2019/01/28/turning-natural-gas-into-carbon-nanotubes-cuts-energy-use-carbon-dioxide-emissions/)

We seek ambitious, motivated problem solvers with sound science and engineering backgrounds.

CNT Fiber Spinning and Processing - https://jobs.rice.edu/postings/21995

CNT Synthesis and Reaction Engineering - https://jobs.rice.edu/postings/21996

Rice Academy Post-Doctoral Fellow - https://jobs.rice.edu/postings/21937
CARBON NANOTUBE REACTION SYSTEM

- **Carrier Gases:** H₂, A, N₂, with/without water or no carrier gas at all
- **Reactor Setpoint Temperatures:** 700-1200°C
- **3-Zone Furnace**

CNT FIBER PROCESS

- **Fiber Spinning Process**
  - Fiber Collection
  - Collection Rate (Dew Point)
- **Dope Properties**
  - CNT Concentration
  - CNT Aspect Ratio (L/D)
  - CNT Quality (G/D)
  - CNT Purity
  - Solvent
- **Spinneret Properties**
  - Extrusion Rate
  - Diameter
  - Die Conditions (Air Gap or Submerged)
- **Coagulation Conditions**
  - Coagulant
  - Bath Length
  - Solvent Concentrations
  - Temperature
  - Bath Orientation

CNT Fiber Electrical Conductivity Development Progression

- **Electrical Conductivity S/m**
  - Copper = 5.96E7 S/m
  - Aluminum = 3.77E7 S/m
  - Platinum = 9.43E6 S/m
  - Titanium = 2.38E6 S/m

- **RICE**

- **CNT BASED EKG WEARABLE, CONTINUOUS SENSOR**

- **30 cm CNT**
- **3M Electrode**

- **Wearable Electronics**
- **High Efficiency Electric Motors**
- **Cardiac Sutures**
- **Bulletproof Vests**
- **Space Elevator**