# Implementation of a strategy for achieving extraordinary levels of surface area and porosity in crystals

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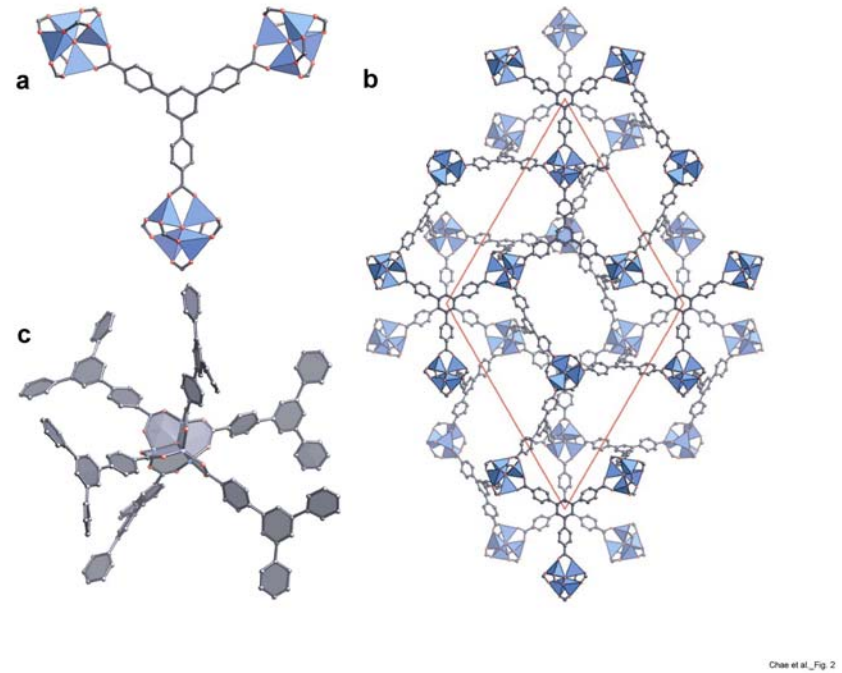
**One of the outstanding challenges in the field of porous materials is the design and synthesis of chemical structures with exceptionally high surface areas1. Until recently the highest surface area for a disordered structure was that of carbon (2,030 m2/g), and for an ordered structures was that of zeolite Y (904 m2/g). More recently we, and others, have reported crystals of metal-organic frameworks (MOFs) with similar or somewhat higher surface areas. Despite this progress and the critical importance of high surface area to many applications involving catalysis, separation and gas storage, no strategy has yet been outlined to answer the question of what the upper limit in surface area for a material is, and how it might be achieved. Here we present a general strategy that has allowed us to realize a structure having, by far, the highest surface area reported to date. Specifically, we report on the design, synthesis and properties of crystalline Zn4O(BTB)2 (BTB = 1,3,5-benzenetribenzoate), a new metal-organic framework (named MOF-177) with a surface area of 4,500 m2/g. We also show that MOF-177 combines this exceptional level of surface area with an ordered structure that has extra-large pores capable of binding polycyclic organic guest molecules–attributes heretofore unrealized in one material. (accepted to nature)**




The structure of MOF-177. **a**, A BTB unit linked to three OZn4 units (H atoms are omitted). ZnO4 tetrahedra are shown in blue and O, C atoms are shown as red, black spheres. **b**, The structure projected down [001] similarly illustrated. For clarity only about half the **c** axis repeat unit is shown. **c**, A fragment of the structure radiating from a central OZn4: six-membered rings are shown as gray hexagons and Zn atoms as blue spheres.

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## Education:

One undergraduates (Don Allison), a visiting student (Young-Bok) and a visiting scholar (Dr. Hee Chae) from S. Korea. The project is being developed at present by a 4th year graduate student (Nate Ockwig) and a first year graduate student from Puerto Rico (Lidaris Miguel). Students involved in this project learn solution and solid state chemistry synthesis techniques, which historically have been regarded separate disciplines. Indeed students on this project experience chemistry from the discovery stage all the way to applications (ie. synthesis, characterization, study of properties and applications of the materials synthesized to gas separations and storage).

## Outreach:

PI is continually involved in a web based project "Reticular Chemistry Structure Resource" which aims to combine the expertise of Biologists and Chemists in building structures with Mathematician's ability to enumerate the possible structures that might result. This project is heavily invested in communicating to others outside chemistry and incorporating into the chemistry college curriculum the most important conceptual tools that chemists use in interpreting and classifying structures.