**Docket #:** S12-369

# Method of Organic Semiconductor Thin Film

Although organic thin film transistors (OTFTs) made from organic semiconductors are valued for their transparency, flexibility and low cost attributes, their sluggish response time due to slow carrier mobility limits their applications. Recently, researchers at Stanford University have developed an inexpensive method of manufacturing OTFTs that increases carrier mobility to a degree that enables high performance organic electronics. This solution based processing method, known as solution shearing, incrementally induces lattice strain to create greater electron orbital overlap between the component molecules. The method's simplicity and compatibility adds little additional costs to roll to roll shearing processes yet can improve the average mobility by four times or more. The technique can be adjusted to provide new opportunities for tuning electronic properties and is scalable to large area thin film electronics. Stanford researchers have opened the door for advancements in solar cells, flexible displays, printed chips, and other performance driven electronics.

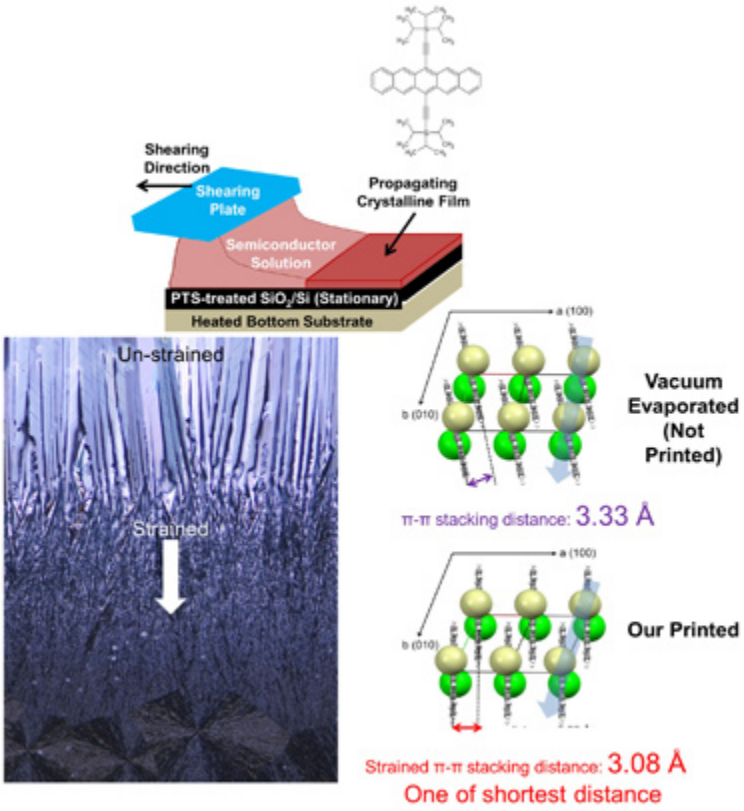



**Figure Caption:**
Top: Schematic of the Solution Shearing method.
Left and Right: Visual of the method's influence on thin film crystals, molecular packing and electronic orbital overlap.

**Stage of Research**
Manufactured and tested samples $1cm^2$ to $2in^2$ in area with an increase in carrier mobility as much as 4-10 times.

# Applications

- Photovoltaics
- Organic electronics
- Roll to roll coating process (also known as blade coating, knife coating, flow coating, slide coating, and zone casting)
- Flexible displays
- Printed chips
- Disposable sensors such as Radio frequency ID tags

## Advantages

- Improves performance by increasing mobility
- Method applicable across a range of molecules
- Flexible, transparent and inexpensive electronics
- Process compatible with existing roll to roll manufacturing
- Control of molecular packing after molecule selection
- Tunable electronic properties
- Scalable to large area thin films

## Publications


- Giri, Gaurav, Eric Verploegen, Stefan C. B. Mannsfeld, Sule, Atahan-Evrenk, Do Hwan Kim, Sang Yoon Lee, Hector A. Becerril, Alán Aspuru-Guzik, Michael F. Toney, and Zhenan Bao, Tuning charge transport in solution-sheared organic semiconductors using lattice strain, Nature (2011), 480(7378): 504–508, published online 21 December 2011, DOI: 10.1038/nature10683
- Wen-Ya Lee, Joon Hak Oh, Sabin-Lucian Suraru, Wen-Chang Chen, Frank Würthner, Zhenan Bao, High-Mobility Air-Stable Solution-Shear-Processed n-Channel Organic Transistors Based on Core-Chlorinated Naphthalene Diimides, Advanced Functional Materials, Vol. 21, Issue 21, pp. 4173-4181, November 8, 2011, published online 4 October 2011, DOI: 10.1002/adfm.201101606.


## Patents

- Published Application: 20140093997
- Published Application: 20140256085
- Issued: 9,070,881 (USA)

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