Inorganic-Organic Hybrid Perovskites

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Hybrid Perovskites

- **Interest**
  - Unique physical properties
  - Applications in technology
  - Ease of processing
  - Tunability
  - Flexibility
  - Low Cost

Crystal Structure

- Perovskite-based
  - Series of corner-sharing octahedron
  - Band gap structure
  - Electron transport in layered material

Mitzi et. al., *IBM J. Res. & Dev.* 45, no. 1 (2001)
**Structural Characteristics**

- **Inorganic**: $M^{2+}$ and halides
  - Dimensionality
  - Semiconductor, metallic, magnetic
  - Symmetry and vacancies

- **Organic**: Protonated Amines
  - Hydrogen bonding, vdW, stacking
  - Intercalation
  - Shape constraints

\[
(C_4H_9NH_3)_2 PbX_4
\]

Inorganic Layers

- Band gap series

\[
(C_4H_9NH_3)_2\text{PbX}_4
\]

\[
(C_4H_9NH_3)_{2}(\text{CH}_3\text{NH}_3)_{n-1}\text{Sn}_n\text{I}_{3n+1}
\]

- Conductivity

Mitzi et. al., *IBM J. Res. & Dev.* 45, 1 (2001)
Organic Layer

- Organic-Inorganic LEDs
- Polymerization reactions
- Structure/mobility
- Perturbations of structure due to confinement

Mitzi et. al., *IBM J. Res. & Dev.* 45, 1 (2001)
Synthesis

- Thin film deposition
  - saturation solutions
  - spin-coating
  - Single source thermal ablation (SSTA)

- Annealing

- Single source thermal ablation (SSTA)

**SSTA Details:**
- 1000 C in <5 sec
- Film thickness 10 – 200 nm
- Roughness <2 nm (RMS)
- (00l) orientation, crystalline in stacking

Mitzi et. al. (2001 and 2004)

Current EL <1% efficiency