

BASF
The Chemical Company

Progress on deep blue triplet emitters for OLEDs

Innovationsforum, Anwendung von OLED für Beleuchtung
Jena, 20.-21. Feb. 2008

Dr. Elmar Keßenich
BASF Future Business GmbH

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Two companies - one goal

Future business for BASF



BASF Future Business GmbH

Internal ventures

- Founded 1 April, 2001
- 100% subsidiary of BASF AG
- Headquarter in Ludwigshafen
- 17 direct employees*
 - Ludwigshafen, Germany
 - Somerset, USA
 - Hong Kong, China
- ~300 people involved in projects across BASF

BASF Venture Capital GmbH

External ventures

- Founded 1 April, 2001
- 100% subsidiary of BFB
- Headquarter in Ludwigshafen
- 13 employees
 - Ludwigshafen, Germany
 - Fremont, USA
 - Hong Kong, China
- Vested with €100 million


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BASF Future Business GmbH

Our Mission



- Identification and development of new business segments for BASF group
 - Outside the existing global and regional business units
 - Based on chemistry and/or related technologies
 - Markets with above-average growth rates
- Building a sustainable competitive position in these segments
 - Selecting the appropriate business model
 - Developing proprietary technology and system solutions
 - Establishing partnerships
- Investing in new technology-based companies and funds
 - Return on investment adequate to the high risk
 - Window on technology



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Topic Focus & Competence Cluster

Energy Management

- OLED Lighting
- Photovoltaics
- Printed Electronic
- Fuel Cells
- Thermoelectric
- Batteries
- Capacitors

Organic Electronics

Nano- & Biological Materials

- Performance Microorganism
- Smart Textiles
- New Mat. for Medical Devices

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5

Lighting Currently Uses 20% of all Electrical Energy Worldwide

- Huge potential for energy saving
- Here you can see all our customers

Photo courtesy of C. Mouheir & R. Simpson (NASA/GSFC), NOAA/NGDC, DLR

OLED technology

Simple OLED setup

Labels in diagram:

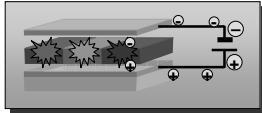
- metal electrode
- organic transport material
- emissive layer
- organic transport material
- transparent and conducting substrate

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7

OLED-light sources – application in displays and lighting



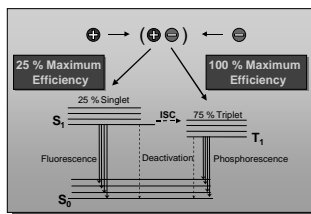
- Red, green and blue emission is needed for a good white
- For high efficiency, phosphorescent emitters are needed (=metal complexes)
- Good blue emitter-systems are still not available
Key-problem for OLED-lighting today!

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8

Organic Light Emitting Diodes – Why Triplet Emitters



- Recombination gives 75% Triplet and 25% Singlet states
- Fluorescent Emitters only take advantage of the 25% Singlet fraction
- Only Phosphorescent (triplet) emitters can give up to 100% internal efficiency

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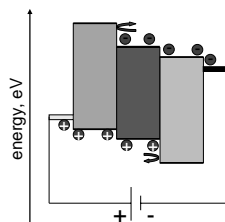
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Material properties



When developing new materials one should think of...

- | | |
|--------------------------|-------------------|
| transport levels | → IP and EA |
| emission energy | → S_1 and T_1 |
| transport prop. | → $\mu(F)$ |
| morphological stability | → T_g |
| ... | |
| aggregation tendency | → polarity |
| thermal stability | |
| charge carrier stability | |
| photophysical stability | |
| ... | |



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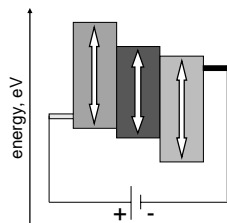
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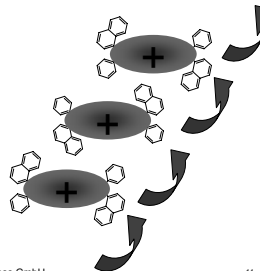
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14

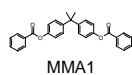
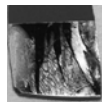
Material properties



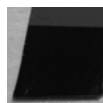
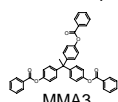
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crystallized film



amorphous film



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15

