POLYMERS

MEET

3M™ BORON NITRIDE

THERMALLY CONDUCTIVE & ELECTRICALLY INSULATING
Downsizing. Lightweight and complex geometries. Better heat dissipation in high-power E & E applications. These challenges require materials that can effectively spread heat within a small space and transfer it to the surrounding air. Plastics are the material of choice, but they are generally not thermally conductive. Adding 3M™ Boron Nitride as filler material is an easy way to resolve this issue.

The presented functionally integrated LED flashlight developed by a team of experts also decreases the number of components needed and therefore the total system costs. As it is electrically insulating, the 3M™ Boron Nitride filled compound can be directly injection molded around the printed circuit board (PCB), and it covers the functions of the heat sink as well as the reflector.

Light is on, but the heat is off
The HSMtec PCB with its integrated copper parts is perfectly suited for over-molding with polymers.

- Standard FR4 PCB technology for high-power LEDs
- Selectively integrated massive copper parts allow for excellent heat spreading
- LEDs and control electronics in one PCB
- 3-dimensional designs possible
- Multilayer electronic layouts

Involved project experts and their roles

3M
Initiator of LED flashlight project. Manufacturer of 3M™ Boron Nitride.

HAUSERMANN
manufacturer of printed circuit board.

Lehmann&Voss+Co.
Development and manufacture of made-to-measure compound.

OSRAM Opto Semiconductors
LED supplier.

RFPLAST
Thermal modeling. Tool design. Injection mold.

The HB-LED Heat transfer
Thermoplastic material

Manufacturer of printed circuit board.
Development and manufacturing of made-to-measure compound.
3M™ Boron Nitride Cooling Fillers for thermally conductive thermoplastics and thermosets with up to 15 W/mK in-plane and ≥ 3 W/mK through-plane.

- Electrical resistance > $10^{15}$ Ohm*cm
- High dielectric breakdown voltage
- 95% reflectivity
- Lightweight
- Non-abrasive and gentle on tools
- Excellent processability

The PET-based compound LUVOCOM® 1800-9333/WT offers high thermal conductivity but remains electrically insulating thanks to the use of a new Boron Nitride from 3M.

- Thermal conductivity of 8 W/mK
- Good mechanical properties
- Optimized adhesion at the PCB
- Individually colored for tailored designs
- Highly suitable for injection molding
The prototype tool insert for injection molding was designed by RF Plast specifically for the required applications.

- Thermal simulation via SolidWorks® for optimum part design
- Simulation of injection molding via Moldflow® Insight for optimization of
  - mold filling
  - compound cooling
  - warping

Expertise in injection molding thermally conductive polymers

The good flow and molding properties of the 3M™ Boron Nitride filled compound allow manufacturing in one shot. Complex and thin-walled geometries can be realized. Low injection pressures enable the functional integration of printed circuit boards and other electronic components. The hot polymer melt perfectly wets out the rough and contoured surface of the PCB. When using the dry-lubricating 3M™ Boron Nitride Cooling Filler, neither the electronic parts nor the injection tools do not see any wear.
Excellent results

The heat generated by the LED is spread by the printed circuit board and dissipated by the thermally conductive polymer. The measured temperature of the LED – showing a light performance of a 40-watt light bulb – does not exceed 80 °C at the LED junction and 40 °C at the housing. Without 3M™ Boron Nitride Cooling Fillers, the temperature would be much higher than 150 °C and would destroy the LED.

Conventional polymer
Conventional polymer

Thermally conductive polymer

Functional integration

- Low development cost and time
- One-step manufacturing
- Reduced investment
- Excellent heat management guarantees highest lifetime of LED
- New design opportunities
- 30 % lowering of costs compared with previous solutions using metal housing

* example for a thermal simulation with 4 W/mK integral
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