

ADVANCES IN
MATERIALS
FOR CONSUMER
PRODUCTS

TABLE OF CONTENTS

Introduction	3
Plastics: The Great Polarizer	5
Biopolymers & (Almost) Biopolymers	6
Current Issues with Compostability & Recyclability	10
Advances in Elastomers	12
Recycled Plastics	15
Advances in Aesthetics and Pigmentation	23
New fiber reinforcement	23
Ceramics: Thousands of Years Old, Utterly New	27
Materials	28
Molded Ceramic Parts	31
Coloring of Ceramic Parts	36
Coatings	40
Lighting & Embedded Electronics	46
Thinner, Cooler, Transparent & Flexible	46
Organic LEDs	48
Light Emitting Capacitors	50
Manufacturer Contact Information	62
About Us	72

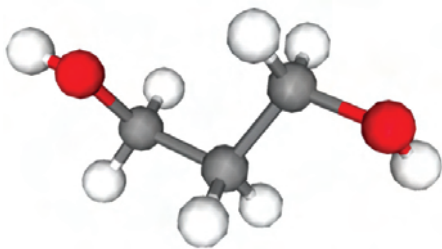
GENERAL INTRODUCTION

Despite the oft quoted statement that we were glad that 2009 was over, the pace of innovation did not appear to abate at all in the world of material development for consumer products.

The area of material development for these products also saw a number of successes, with areas such as durable bioplastics, recycled content products, printed electronics, OLEDs and more molded ceramic items making the headlines. It is always hard to predict exactly where innovations in materials will ultimately end up, because there are myriad factors in the ultimate deployment and success of a material. Obvious technology transfers from either high tech to consumer tech or even between different consumer product groups do not always go as planned, again due to small but critical elements required to make any product successful. Sustainability has clearly influenced many material developments, both from an economic and efficiency standpoint as well as the less easy to quantify effect on the planet. We have seen an evolution in the way sustainability has been defined in consumer products, and a greater emphasis on quantifiable data from analysis such as LCA rather than qualitative and often unverifiable statements on 'greenness'. Indeed greater transparency in material usage overall is being seen, with a clear understanding that consumers are more knowledgeable about their products and their contents.

Individual introductions at the beginning of each of the four parts; Plastics, Ceramics, Lighting and Embedded electronics and Coatings give a flavor of what can be found in those sections, and highlight what each area is likely to give us in material innovation the coming two years.

Overall, I feel that we are reaching a better understanding of what our current palette of materials is capable of and though this may seem at first limiting, give us a better roadmap of how to use them sustainably. Noticeably absent from this report are some of the more advanced developments in nanotechnology, biomaterials and smart materials. These do have a role to play in innovation in the future, but I felt that their chances of being implemented in the consumer product world in the next couple of years was relatively slim so will leave breathy exhortations about nanotech saving the world to others. ■



propanediol: 1,3-Propanediol is an organic compound synthesized from corn sugar used mostly in the production of plastic compounds such as composites, adhesives, laminates, coatings, moldings, aliphatic polyesters and copolyesters. It is also used as an antifreeze.

Not All Bioplastics are Compostable

It is worth noting that some of the more recently developed bioplastics such as **Braschem's HDPE**, **Arkema's nylon** resins from castor oil and the **Hytrel** blends from **Cerenol polyols** derived from **propanediol** (PDO) obtained from bacterial fermentation of corn sugar, are designed as 'durable' plastics and are not compostable or quickly biodegradable. These bioplastics claim lower impact status by their use of renewable resources that sequester carbon during their growth, with the intention being to recycle them at the end of their life. Table 2 below shows **the key current and future players and materials in this industry**. Some of these are in the early stages of commercialization and penetration of the marketplace, others such as the bio-based acrylics are in the development stages. As more new bio-derived monomers such as **Isosorbide** (an organic nitrate), **Succinic Acid** (also known as **spirit of amber**, a dicarboxylic acid), **3-Hydroxy Propionic Acid** (also a **carboxylic acid**), **Aspartic Acid** (an amino acid), **Levulinic Acid** (a combination of sucrose and hydrochloric acid), **Sorbitol** (a sugar alcohol sweetener), and **Glycerol** become available and price competitive, we will see additional products enter the marketplace based upon the polymerization of these chemicals. Of course the existing major bioplastics will still find a market in the

single-use disposable field and in semi-durable products. In the end this is no different than the path already taken in the development and market segmentation of conventional oil-based plastics in use today.

Table 2. Key Future & Current Bioplastics Industry Players & Products

Who?	What?	Commercialization Stage
DURABLE		
Braschem	HDPE, LLDPE, PP	200,000 metric ton capacity plant planned for 2010
Dow/Crystalsev	HDPE	350,000 metric ton plant in 2011
Du Pont	PTT;PBT;Nylon 6,12	Commercially available
Arkema	Nylon 11, Pebax	Commercially available
BASF	Nylon 6, 10	Commercially available
Rohm & Haas	Acrylics	In Development
Dow, Cargill	Soy based Urethane	Commercially Available
Cereplast	Biopropylene	Commercially available
DEGRADABLE		
Novamont	Origo Bi©	60,000 tons per annum
Natureworks	PLA	140,000 tons per annum
Metabolix	PHA's	50,000 metric ton plant planned for 2010
DSM	PHA's	China's largest manufacturing plant for PHA's being funded

Source: Jim Lunt & Associates LLC

Plastics from waste CO₂

We know that one of the major advantages of using bioplastics is their reduction in carbon footprint due to the plants they are manufactured from sequestering carbon during their growth (corn when growing absorbs CO₂ from the atmosphere during photosynthesis). Well **Novomer**,

impact of these TPUs; “**Pearlthane ECO** creates 40% less global warming emissions. Stated simply, for every 10,000 metric tons of **ECO** TPU that is produced in place of fossil hydrocarbon-based TPU, up to 20,000 fewer barrels of crude oil are consumed, which is equivalent to the energy required by approximately 1500 houses in Germany.”

The resin is being currently used in the frames of **Smith Optics' Prodigy** ski goggles where the TPU blend contained 44% bio-based raw materials (www.smithoptics.com).

New York based housewares designer **Casabella** is commercially producing cutlery trays from a biodegradable, corn-based plastic called **Mater-Bi®** from **Novamont**. These debuted at the 2009 Housewares Show in Chicago and are to go on sale in the US in 2010.

▼ **Mater-Bi**, a combination of starch and a polyesters from vegetable oil is a perfect resin for this molded silverware tray.



SMITH GOGGLES ▼

The use of Pearlthane ECO is a first for bio-based polyurethane in a sporting application of this type.



◀ **DUPONT SKI BOOT**

The bio based Hytel resin used in this ski-boot performs exactly the same as its petrochemical-based alternative.

