Optics for Energy Lecture 6
Optics for Recycling

http://lons.utah.edu/
Ref: A. Nordbryhn, Optics & Photonics News June 2012.
Application: Reverse Vending Machines

Some Companies in this space:
Envipco, USA
Wincor Nixdorf, Germany
Tomra, Norway

Challenge: Need to identify & sort waste at high speeds and into multiple categories for recycling.
Solution: Optics.
Shape Measurement Techniques

High accuracy needed.
Early systems used photocells on conveyor belts.
Another approach is laser range finding.

Laser modulated. Phase of reflected (modulated) laser is shifted based on distance of target. Distance can be extracted by measuring this phase shift.

A 3-D crate imager based on a scanning laser range finder. The diameter of the scan arc is 50 cm.
Stereo Vision Systems

Combine 2 cameras & image processing for fast, accurate shape recognition.
Quick Note on recycling markets

Single-use vs multi-use containers
Container deposit - non-participants finance equipment.
In non-deposit markets, commodity prices drive this industry.
Accurate sorting & efficient transportation are key driving factors.
Recycling Plastics is Challenging

Solution is Near-infrared Spectroscopy
Correlation Spectroscopy

Relatively inexpensive & simple

A halogen lamp & a InGaAs detector may be used.

Filter wheel (with plastics)  Entrance to a machine
Diffractive-optical element (DOE) for low-cost spectrometry

A single DOE can be used for beam-splitting, spectrum separation & focusing.
Large-scale materials sorting

Municipal and other large-scale waste contains valuable materials resources but requires large-scale, high throughput sorting.

Example: 30 tons of waste per hour. Both NIR and Vis spectra captured with spatial resolution of a few cms at high speed.

Why? Aluminum costs $1.30 to $2.20/kg. Can be melted & recast into containers & other items. PET plastic costs $1.30 to $1.60/kg. Can be turned into fiber & used for fleece, fabrics, etc.
Large scale Material Recovery Facility (MRF)

(Left) MRF running at full speed, sorting valuable materials from a municipal waste stream. (Right) Incident light is generated by a number of reflector halogen lamps. Reflected light is imaged and spectrally analyzed in the scanner.
The innovative idea

A “smart” garbage can device that reads SPI code
- Made for plastic bottle waste
- Will sort bottles into correct section

Round Garbage Can Design
Eight columnar sections for compartmentalized sorting

Camera, opener motor and electronics are in rotatable-motor section