

Aluminum Laminated Film for Pouch Cell Research: Structure, Properties, and Handling

A practical guide to understanding aluminum laminated film for pouch cells: the three-layer structure, what each layer does, heat sealing parameters, and how to handle and store the material without damaging it.

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What Is Aluminum Laminated Film?

Aluminum laminated film—also called aluminum plastic film, pouch film, or laminate film—is the flexible packaging material used to encase the electrode stack in a pouch-type lithium battery. Unlike cylindrical or prismatic cells with rigid metal housings, a pouch cell uses this thin multilayer film as its only barrier against the environment. That makes the film selection and handling critical: a pinhole, crease, or delamination in the wrong place means electrolyte leakage or moisture ingress, and the cell fails.

For laboratory research, aluminum laminated film serves the same purpose as it does in commercial cells—it just needs to work reliably in small, hand-assembled batches where consistency is harder to control than on an automated production line.

The Three-Layer Structure

Every aluminum laminated film is a composite of three functional layers. Understanding what each layer does helps you understand why handling and storage matter.

Outer Layer: Oriented Nylon (ONY), 25 µm

The outer surface of the film faces the environment. Oriented nylon (also called biaxially oriented polyamide, OPA) provides:

- **Mechanical toughness:** nylon resists puncture and abrasion better than most films of equivalent thickness. This is what prevents the pouch from being damaged by electrode edges during assembly.
- **Printability:** commercial cells use this surface for labeling; in research applications this is less relevant, but the layer still provides the external mechanical protection.
- **Moderate moisture barrier:** nylon itself absorbs some moisture, which is why the aluminum layer underneath does the heavy lifting as the true moisture barrier.

Middle Layer: Aluminum Foil, 40 µm

This is the critical barrier layer. Aluminum foil at this thickness is essentially **impermeable to both water vapor and oxygen**. The water vapor transmission rate for the complete laminate is $<0.01 \text{ g/m}^2\cdot 24\text{h}$ —orders of magnitude better than any polymer-only film.

Why does this matter for batteries? Moisture reacts with LiPF_6 electrolyte to produce HF, which attacks both the electrode active materials and the current collectors. Even a few parts per million of water in the cell can meaningfully accelerate capacity fade. The aluminum foil layer in the pouch film is the primary defense against moisture ingress through the cell wall (the seal edge is a separate concern, handled by the inner PP layer and sealing tape).

The aluminum foil also provides electromagnetic shielding and gives the film its characteristic metallic appearance.

Inner Layer: Cast Polypropylene (CPP), 40 μm

The inner surface of the film contacts the electrolyte directly. Cast polypropylene was chosen for three reasons:

1. **Electrolyte compatibility:** PP is chemically stable against all standard carbonate-based electrolytes (LiPF_6 in EC/DMC, EMC, etc.) and most ether-based systems. It does not dissolve, swell significantly, or leach contaminants into the electrolyte.
2. **Heat sealability:** PP has a relatively sharp melting transition and seals cleanly at 160–200°C depending on the formulation. The seal bond is to itself (PP-to-PP at the fold) or to the polyimide sealing tape on the tabs.
3. **Low ionic contamination:** polyolefins in general have very low ion concentrations and do not contribute to self-discharge or electrolyte degradation.

Between the aluminum foil and the PP layer there are thin adhesive layers; the total construction for model DM-L113N is ONY 25 μm / adhesive / aluminum 40 μm / adhesive / CPP 40 μm , totaling 113 μm .

Key Specifications for DM-L113N

Property	Value
Total thickness	113 μm
Sheet dimensions (pre-cut)	200 × 100 mm
Outer layer	Oriented nylon (ONY), 25 μm
Middle layer	Aluminum foil, 40 μm
Inner layer	Cast polypropylene (CPP), 40 μm
Heat seal strength	60 N
CPP/Al peel strength	8 N
Water vapor transmission rate	< 0.01 $\text{g/m}^2\cdot 24\text{h}$
Included per pack	10 sheets or 2 sheets, with desiccant

The 200 × 100 mm pre-cut sheet size is appropriate for small research pouch cells with electrode dimensions up to roughly 80 × 60 mm (allowing for the seal margin). For larger electrode formats, contact us for custom sheet sizes.

Heat Sealing

Pouch cells are sealed using a heat press or vacuum sealer that applies both temperature and pressure to the film edge. The CPP inner layer melts and fuses at the seal line, creating the bond.

Typical Sealing Parameters

Parameter	Typical range
Sealing temperature	170–195°C
Sealing pressure	0.3–0.6 MPa
Sealing dwell time	3–6 seconds
Cooling time	5–10 seconds under pressure

These parameters are starting points; the optimal values depend on your specific sealer geometry, jaw size, and heat uniformity. Always run a seal test on scrap film before sealing a real cell: pull the sealed edge apart by hand after cooling—a good seal tears the film rather than peeling cleanly at the bond line.

Sealing Sequence

For a standard three-side sealed pouch cell (assembled by folding the film):

1. Fold the film over the electrode stack, PP side inward
2. Seal the two short edges first (these do not have tabs)
3. Fill with electrolyte through the remaining open long edge
4. Seal the final edge with the tabs in place, in a vacuum chamber if possible (vacuum sealing removes gas pockets from the electrode stack and improves initial cycle performance)

The tab exit points require polyimide tape pre-applied to the tab (see Battery Tab Selection Guide). During heat sealing, the PI tape bonds to the CPP inner layer and creates the hermetic seal around the tab metal.

Handling: Four Rules

Aluminum laminated film is more sensitive to handling than most lab consumables. These four rules prevent the majority of handling-related defects.

1. Always use gloves. Fingerprints deposit oils that locally degrade the adhesion of the PP layer to the aluminum foil. In a research setting where you may only use a few sheets, a delamination defect may not appear until the cell is already assembled and filled—at which point it becomes a leak.

2. Never crease or fold sharply. The aluminum foil layer can crack at a sharp crease. A crease does not always create an immediate through-hole, but a cracked aluminum layer is no longer an effective moisture barrier at that point. When the film is folded to form the pouch, the fold must be a smooth curve with a radius of at least 3–5 mm.

3. Avoid sliding the sheets against each other. The nylon outer surface has moderate abrasion resistance, but sliding two sheets together can scratch the surface in ways that eventually propagate to the aluminum layer under mechanical stress during assembly or cycling.

4. Handle the inner surface (CPP side) with extreme care. Any contamination on the CPP surface—particularly grease, skin oils, or dust particles—creates potential nucleation sites for delamination at the seal line. The PP-to-PP bond during heat sealing is only as good as the cleanliness of the surfaces.

Storage

Aluminum laminated film is moisture-sensitive. Moisture affects both the nylon outer layer (which absorbs water from the air, causing dimensional changes and reducing toughness) and the seal quality (moisture at the seal surface can reduce bond strength).

Storage conditions: sealed in original packaging with the included desiccant, at room temperature away from direct light. Under these conditions, shelf life exceeds 12 months.

After opening: reseal unused sheets in an airtight bag with desiccant. If sheets have been left open to a normal lab atmosphere (40–60% RH) for more than a day, run a test seal on a sample before using the remaining sheets for critical experiments.

Do not store at elevated temperature: above 40°C for extended periods, the adhesive layers can creep and the peel strength between layers may decrease.

Common Failure Modes

Symptom	Cause	Prevention
Delamination at seal edge after cycling	Electrolyte wicking under CPP layer	Ensure clean, grease-free surfaces before sealing; verify sealing temperature
Pinhole at crease	Aluminum foil crack from sharp fold	Use radius ≥ 5 mm at fold; do not fold after filling
Seal does not hold (peels at bond line)	Low temperature or pressure; contaminated surface	Run seal test on scrap first; clean surface with isopropanol before sealing
Film swells locally during cycling	Gas generation from electrode or electrolyte	Check electrode voltage limits and electrolyte stability

Related Products

- [Battery Tab Kit](#) — aluminum and nickel tabs with matched polyimide sealing tape

- [CR2032 Coin Cell Kit](#) — for electrode screening before committing to pouch format
- [Nickel Foam](#) — electrode substrate for pouch cell electrode fabrication

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