

Cast Iron Molecular Polymerization Field Guide

The Organic Chemistry of Lipid Cross-Linking, Smoke Points, and Flaking Prevention

1. Cooking Fat Chemistry & Cross-Linking Evaluation

Fat / Oil Type	Fatty Acid Profile	Polymerization Characteristics & Flake Risk
Flaxseed / Linseed Oil	High Alpha-Linolenic Acid (55% ALA, 3 double bonds)	Hyper-cross-links into ultra-rigid glass polymer. Highly prone to brittle micro-fracture and sheet flaking.
Grapeseed Oil	High Linoleic Acid (70% LA, 2 double bonds)	Balanced cross-linking with moderate elasticity. High smoke point (420°F); ideal baseline seasoning.
Crisco / Canola / Lard	Monounsaturated Oleic + Saturated Triglycerides	Flexible polymer matrix with high thermal shock tolerance. Exceptional adhesion to porous iron pores.
Extra Virgin Olive Oil	High Oleic Acid + Free Fatty Acid impurities	Low smoke point (375°F); chars prematurely into sticky, rancid carbon rather than slick polymer.

2. The Molecular Seasoning & Flake Restoration Protocol

Protocol Phase	Thermal & Mechanical Action	Chemical Outcome
1. Stripping Flakes	Scrub affected zones with chainmail scrubber and coarse kosher salt; dry completely.	Removes unanchored, brittle polymer fragments down to bare iron substrate.
2. Micro-Film Buff	Apply 1/2 tsp grapeseed oil; wipe aggressively with lint-free cotton until pan appears dry.	Leaves molecular mono-layer (~1-2 microns); eliminates pooling and sticky gum spots.
3. Thermal Polymerize	Bake upside-down in oven at 450°F (232°C) for 60 min; cool naturally inside oven.	Achieves radical-initiated lipid cross-linking and full carbon-iron bonding.