

# MECHANISMS OF MILITARY COATINGS DEGRADATION

## POLLUTION PREVENTION VIA EXTENDED COATINGS DURABILITY

Military coating systems are typically reapplied for the following reasons: loss of appearance (aesthetics, camouflage, cleanliness); chipping, peeling, and debonding of the coating; and corrosion of the substrate. Such painting, depainting, and repainting operations comprise a significant source of pollution associated with military operations. The frequency of these operations both increases pollution generation through increased consumption and causes increased economic and logistical burdens associated with the maintenance waste stream. ARL is engaged in a comprehensive military coating system degradation characterization program aimed at identifying and quantifying degradation mechanisms that lead to coating system failures and quantifying the roles of individual coating constituents on the resistance of the coating system to degradation. As a result of this research effort, new durable coating formulations with greater degradation resistance are being identified and transitioned to military users to positively impact survivability and readiness of military systems. This research also provides the additional benefits of establishing a scientific basis for developing durable coating formulations, lifecycle insight to military users for selecting coatings, and confidence in environmentally benign coating systems.

### Impact of Military Coating System Degradation

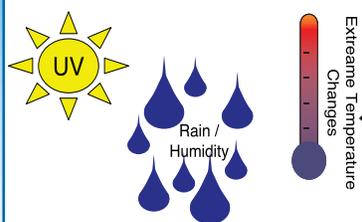
- Environment
- Economics
- Force Survivability
- Force Readiness



### Unique Requirements of Military Coating Systems

- Harsh Service Conditions
- Unique Materials
- Demanding Multifunctional Performance
- Chemical Agent Resistance
- Low-Gloss Camouflage
- Affordability

### EXPOSURES



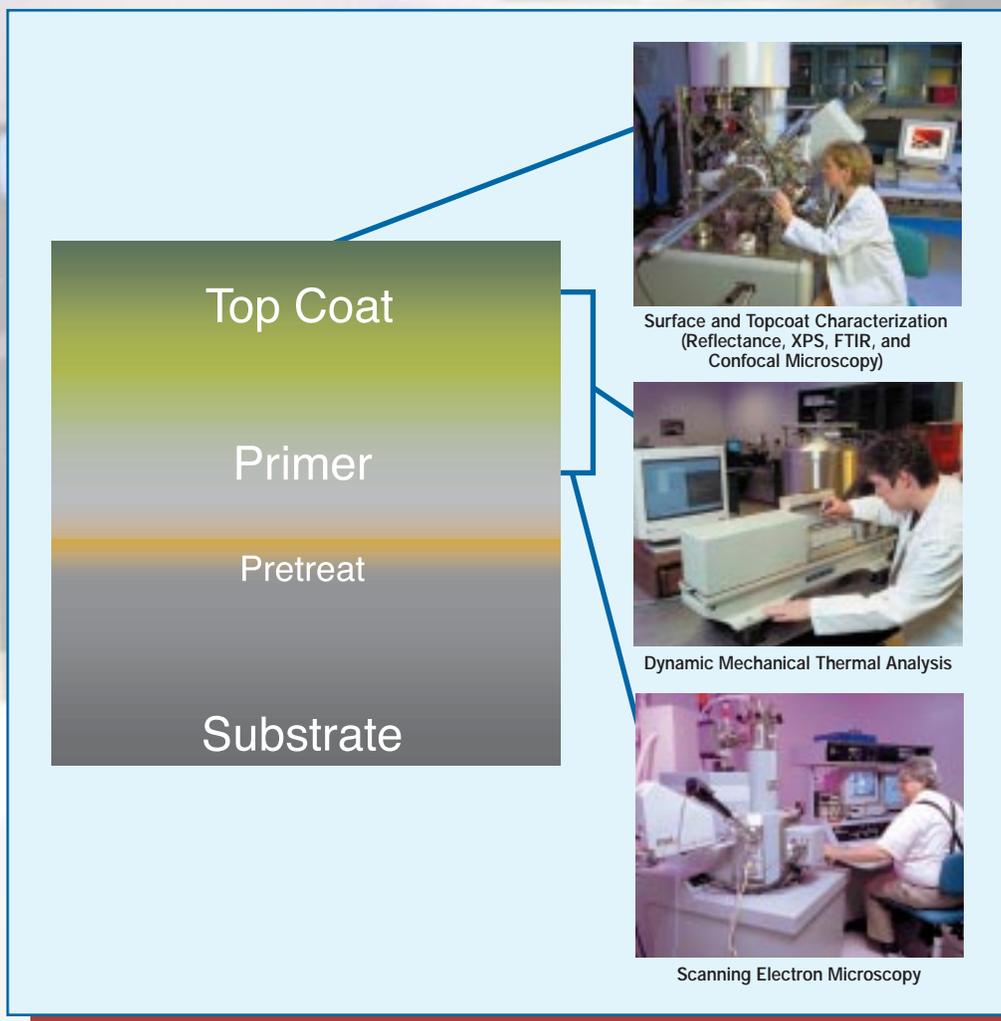
DEGRADATION RESISTANCE HIGHLY LINKED



### Coating Constituents

- Resins (24%)
- Pigments and Extenders (44%)
- Solvent (30%)
- Additives (2%)

ARL's technical approach to coating systems degradation research is focused on investigating military coatings as synergistic systems and relating degradation mechanisms to specific failure modes. A primary objective is to develop a state-of-the-art "collaborative toolbox" to enable the characterization and quantification of micro and macro coating degradation properties, featuring predictive models as appropriate.



### Findings

- UV exposure induces the photo-oxidation mechanism of the topcoat binder
  - UV degradation in near the surface, not throughout the bulk of the topcoat
  - Rate of degradation mechanism is system dependent
- UV degradation behavior was modeled and verified using a multilayered diffusion model
- Surface roughness and topography changes were correlated with exposure times and conditions
- Environmentally benign coatings exhibit excellent durability
- Environmental weathering causes physical aging
- Electrochemical impedance spectroscopy indicates increased crosslinking or densification of topcoat with thermal impact of UV exposure.

### FOR FURTHER INFORMATION

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