

# Chrome Plating Alternatives:

*Thermal Spray, Electroless Plating, and Others*

Thintri Inc. announces the release of *Chrome Plating Alternatives*, a new study on alternatives to traditional chrome plating and their markets. This comprehensive examination of the subject discusses the various technologies, the industries in which they will—and won't—be used, and forecasts to 2011.



## Thintri Inc.

Thintri Inc. provides business and market intelligence for a wide range of technologies through custom consulting, technology assessments, and published market studies.

- ◆ Semiconductors
- ◆ Electronics
- ◆ Photonics
- ◆ Telecommunications
- ◆ Materials engineering

### Contact:

J. Scott Moore, Ph.D., President  
Thintri, Inc.  
25-107 Barker St.  
Mount Kisco, NY 10549  
Phone: 914/242-4615  
Fax: 914/666-4114  
E-mail: [smoore@thintri.com](mailto:smoore@thintri.com)

## Contents

### Chrome Plating Industry

- ◆ Environmental and health issues
- ◆ Effects of pollution control laws
- ◆ The industry today
- ◆ Drawbacks in hard chrome
- ◆ Economic factors

### Chrome Plating Target Market Analysis

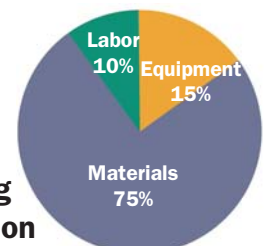
- ◆ Aerospace
- ◆ Industrial
- ◆ Decorative

### Chrome Plating Alternatives

- ◆ Trivalent chrome
- ◆ Plasma spray
- ◆ High-velocity oxy-fuel (HVOF)
- ◆ Electroless nickel-boron plating
- ◆ Electroless nickel composite plating
- ◆ Electrodeposited nanocrystalline cobalt-phosphorus coating
- ◆ Electro-spark deposition
- ◆ Explosive bonding
- ◆ Physical vapor deposition (PVD)
- ◆ Intensified plasma-assisted processing
- ◆ Nickel-cobalt alloy coating

### Market Demand current and 2011 forecast

- ◆ Aerospace
  - Actuator hydraulics
  - Gas turbines
  - Landing gear
  - Other components
- ◆ Automotive
- ◆ Decorative
- ◆ General industry
- ◆ Heavy equipment
- ◆ Oil field applications
- ◆ Power industry



## Background on Chrome Plating Alternatives

Used in a wide range of industries—aerospace, heavy equipment, automotive, papermaking, and others—chrome plating has become increasingly difficult in recent years. Regulations designed to protect against the safety and environmental hazards of hexavalent chrome have increased the cost of chrome plating and burdened facilities performing plating services.

Several alternatives to chrome plating are available. High-velocity oxy-fuel (HVOF) is often favored due to its high performance, relatively low cost, and fast turnaround time. In fact, HVOF will dominate most chrome substitutions. However, several interesting new technologies may establish their own markets within a few years. These include electroless nickel composite plating, which can deposit diamond composite coatings and is not restricted to line-of-sight geometries. Other emerging techniques include explosive bonding, which allows stainless-steel coatings, and electrodeposited nanocrystalline cobalt-phosphorus alloys specifically targeted at inner diameters.

Although many predicted that industry would make a sudden changeover from chrome plating to one of these new technologies, that has failed to happen. Yet some market sectors have made—or are beginning to make—the switch.

And while industry downsizing and consolidation has led to the closure or offshore relocation of as many as half of the chrome plating shops in North America, the chrome plating market today is fairly stable:

- ♦ Many chrome plating shops are now thriving
- ♦ Many customers have little or no interest in giving up on chrome
- ♦ The legislative push toward alternatives has stabilized in North America
- ♦ Europe is ambivalent and Asia is largely unconcerned with regulating chrome plating

Suppliers of alternative coating/plating technologies are facing large but highly segmented markets where chrome plating users are resistant to making large capital investments.

## Understand the Markets

Success for chrome plating alternatives will depend almost completely on economic competitiveness. At a time of tremendous flux and instability—within the supplier and user communities and the economy at large—the course of chrome alternatives in this decade is by no means clear. The success of chrome alternatives will depend on

many factors and ultimately will come down to individual decisions based on economics. Thintri's market study *Chrome Plating Alternatives* examines each alternative technology in detail: its capabilities, its limitations, and its applications. It also explores the potential in each industry and forecasts market growth to 2011.



### Contact:

J. Scott Moore, Ph.D., President  
Thintri, Inc.  
25-107 Barker St.  
Mount Kisco, NY 10549  
Phone: 914/242-4615  
Fax: 914/666-4114  
E-mail: [smoore@thintri.com](mailto:smoore@thintri.com)  
Web: [www.thintri.com](http://www.thintri.com)

**Order your copy today**  
*Chrome Plating Alternatives*  
\$4,800

## Market Segmentation and Forecasts

### Chrome plating, raw materials production

#### Global chrome plating demand

- ♦ Hard chrome
- ♦ Decorative chrome

#### Applications and demand for hard chrome:

- ♦ Aerospace
- ♦ Heavy equipment
- ♦ Oil and gas
- ♦ Other industrial

#### Aerospace hard chrome plating activity, defense vs. commercial

#### Gas turbine hard chrome markets

- ♦ Aerospace
- ♦ Industrial land-based turbines

#### Aerospace hard chrome markets, manufacturing vs. repair

#### Realistic target markets for chrome plating alternatives

#### Thermal spray markets and forecasts

- ♦ Global markets in thermal spray
- ♦ Segmentation by application
- ♦ Thermal spray in wear coatings, forecasts
  - Powders
  - Equipment

#### Thermal spray in wear coatings for chrome replacement, forecasts

#### Thermal spray, aerospace markets for chrome replacement, forecasts

- ♦ Powders
- ♦ Equipment
- ♦ Outsource vs. in-house processing
- ♦ Manufacture vs. repair

#### Chrome replacement in wear coatings, segmentation by method and forecasts

#### Chrome replacement in wear coatings, forecasts by application

#### Geographic segmentation, thermal spray for chrome replacement

#### Thermal spray, processing cost breakdown

#### Decorative chrome replacement, forecasts

- ♦ Trivalent chrome
- ♦ Electroless nickel

# Report Contents

## Chapter 1: Executive Summary

## Chapter 2: Introduction

## Chapter 3: The Chrome Plating Industry

- 3.1 Chromium
- 3.2 Chrome Plating
- 3.3 Health and Environmental Effects
- 3.4 Effects of Pollution Control Legislation
- 3.5 The Industry Today

## Chapter 4: Market Drivers and Target Markets

- 4.1 Overview: The Need for Chrome Plating Alternatives
- 4.2 Target Markets in Chrome Plating
  - 4.2.1 Decorative Chrome Plating Markets
  - 4.2.2 Hard Chrome Plating Markets
    - 4.2.2.1 Aerospace Markets for Hard Chrome Plating
      - 4.2.2.1.1 Actuator Hydraulics
      - 4.2.2.1.2 Landing Gear
      - 4.2.2.1.3 Gas Turbines
      - 4.2.2.1.4 Other Aircraft Components
    - 4.2.2.2 Oil Field, Heavy Equipment and General Industrial Markets for Hard Chrome
- 4.2 Drawbacks in Using Hard Chrome
- 4.3 Economic Factors

## Chapter 5: Chrome Plate Alternative Technologies

- 5.1 Trivalent Chromium
- 5.2 Plated Tin Alloys
- 5.3 Thermal Spray
  - 5.3.1 Thermal Spray Technologies Today
  - 5.3.2 Plasma Spray
  - 5.3.3 High Velocity Oxy-Fuel (HVOF)
  - 5.3.4 Twin Wire Arc Spray
  - 5.3.5 Powders
  - 5.3.6 Line of Sight, Inner Diameter Issues
  - 5.3.7 Stripping and Grinding Issues

## 5.4 Plating Options

- 5.4.1 Electroless Nickel Plating
  - 5.4.1.1 Electroless Nickel Boron
  - 5.4.1.2 Electroless Nickel Composite Plating
- 5.4.2 Electrodeposited Nanocrystalline Coatings
- 5.4.3 Plated Nickel-Cobalt Alloys

## 5.5 Electrospark Deposition

## 5.6 Explosive Bonding

## 5.7 Laser Cladding

## 5.8 Vacuum Techniques

- 5.8.1 PVD
- 5.8.2 Intensified Plasma-Assisted Processing

## Chapter 6: Market Forecasts

### 6.1 Target Markets, Penetration

### 6.2 General Industrial Demand and Forecasts

- 6.2.1 Oil Field Applications
- 6.2.2 Heavy Equipment
- 6.2.3 Other General Industry

### 6.3 Aerospace Demand and Forecasts

- 6.3.1 Commercial vs. Defense Demand
- 6.3.2 Opportunities in Overhaul and Repair vs. Manufacture
- 6.3.3 Landing Gear
- 6.3.4 Aircraft Hydraulics
- 6.3.5 Gas Turbines
  - 6.3.5.1 Aircraft Gas Turbines
  - 6.3.5.2 IGTs
- 6.3.6 Other Aerospace Applications

### 6.4 Thermal Spray Supplier Markets and Forecasts

- 6.4.1 Wear Coatings Markets
- 6.4.2 Cost Issues
- 6.4.3 Geographic Segmentation
- 6.4.4 Powder Providers and Markets
- 6.4.5 Equipment Providers and Markets
- 6.4.6 HVOF vs. Plasma vs. Wire Arc

### 6.5 Markets For Decorative Chrome Alternatives

### 6.6 Health & Environmental Issues

See Tables and Figures next page

## Tables

Table 3-1	Domestic Sodium Dichromate & Chromic Acid Production, US
Table 3-2	Typical Process Parameters for Chrome Plating, Conventional Baths
Table 3-3	Symptoms of Hexavalent Chromium Exposure Among Chrome Plating and Chromium Chemical Workers
Table 6-1	Realistic Hard Chrome Target Markets
Table 6-2	Time Study Results, HVOF vs. Chrome Plating on a Landing Gear Piston

## Figures

Fig. 3-1	California Statewide Air Toxics Summary, Chromium Emissions
Fig. 4-1	Worldwide Chrome Plating Demand, Hard vs. Decorative, 2003
Fig. 4-2	Geographic Distribution, Hard Chrome Production
Fig. 4-3	Global Hard Chrome Market Breakdown, 2003
Fig. 4-4	Aerospace Chrome Plating Market Segments, 2003
Fig. 4-5	Aerospace Hard Chrome Markets, Commercial vs. Defense, 2003
Fig. 4-6	Hard Chrome Demand Segmentation in Gas Turbines, Aerospace vs. IGT, 2003
Fig. 6-1	Hard Chrome Target Market Forecast, Oil and Gas Applications
Fig. 6-2	Thermal Spray Powder Forecast, Chrome Replacement, Oil and Gas Sector
Fig. 6-3	Thermal Spray Equipment Forecast, Chrome Replacement, Oil and Gas Sector
Fig. 6-4	Hard Chrome Target Market Forecast, Heavy Equipment Applications
Fig. 6-5	Thermal Spray Powder Forecast, Chrome Replacement, Heavy Equipment
Fig. 6-6	Thermal Spray Equipment Forecast, Chrome Replacement, Heavy Equipment
Fig. 6-7	Hard Chrome Target Market Forecast, Other General Industry Applications
Fig. 6-8	Thermal Spray Powder Forecast, Chrome Replacement, Other General Industry
Fig. 6-9	Thermal Spray Equipment Forecast, Chrome Replacement, Other General Industry
Fig. 6-10	Hard Chrome Target Market Forecast, Aerospace Applications
Fig. 6-11	Defense vs. Commercial Aerospace Demand, Thermal Spray Powder in Chrome Replacement
Fig. 6-12	Defense vs. Commercial Aerospace Demand, Thermal Spray Equipment in Chrome Replacement
Fig. 6-13	Aerospace Thermal Spray Opportunities in Chrome Replacement, Manufacture vs. Repair
Fig. 6-14	Aerospace Overhaul & Repair, Outsource vs. In-House
Fig. 6-15	Hard Chrome Target Market Forecast, Landing Gear
Fig. 6-16	Thermal Spray Powder Forecast, Chrome Replacement, Landing Gear
Fig. 6-17	Thermal Spray Equipment Forecast, Chrome Replacement, Landing Gear
Fig. 6-18	Hard Chrome Target Market Forecast, Aircraft Hydraulics
Fig. 6-19	Thermal Spray Powder Forecast, Chrome Replacement, Aircraft Hydraulics
Fig. 6-20	Thermal Spray Equipment Forecast, Chrome Replacement, Aircraft Hydraulics
Fig. 6-21	Hard Chrome Target Market Forecast, Gas Turbines
Fig. 6-22	Thermal Spray Powder Forecast, Chrome Replacement, Aircraft Gas Turbines
Fig. 6-23	Thermal Spray Equipment Forecast, Chrome Replacement, Aircraft Gas Turbines
Fig. 6-24	Thermal Spray Powder Forecast, Chrome Replacement, IGTs
Fig. 6-25	Thermal Spray Equipment Forecast, Chrome Replacement, IGTs
Fig. 6-26	Hard Chrome Target Market Forecast, Other Aerospace Applications
Fig. 6-27	Thermal Spray Powder Forecast, Chrome Replacement, Other Aerospace
Fig. 6-28	Thermal Spray Equipment Forecast, Chrome Replacement, Other Aerospace
Fig. 6-29	Overall Thermal Spray Market Forecast, All Applications
Fig. 6-30	Overall Thermal Spray Wear Coatings Market Forecast
Fig. 6-31	Thermal Spray Wear Coatings Market Forecast Confined to Chrome Replacement
Fig. 6-32	Cost Breakdown, Thermal Spray Coatings
Fig. 6-33	Evolution of HVOF Carbide Powder Prices, Combined Average for WC-Co
Fig. 6-34	Geographic Segmentation and Forecast, Thermal Spray Powders, Chrome Replacement
Fig. 6-35	Geographic Segmentation and Forecast, Thermal Spray Equipment, Chrome Replacement
Fig. 6-36	Thermal Spray Powder Market Segments, 2003
Fig. 6-37	Overall Thermal Spray Wear Coating Powder Forecast
Fig. 6-38	Thermal Spray Wear Coating Powder Forecast, Chrome Replacement
Fig. 6-39	Market Share, Carbide Powder Producers, 2003 and 2008
Fig. 6-40	Overall Thermal Spray Wear Coating Equipment Market Forecast
Fig. 6-41	Thermal Spray Wear Coating Equipment Markets, Chrome Replacement
Fig. 6-42	Market Share, Thermal Spray Equipment Producers, 2003 and 2008
Fig. 6-43	Market Share, Plasma Spray Equipment Producers, 2003
Fig. 6-44	Market Share, HVOF Equipment Producers, 2003
Fig. 6-45	Market Share, Wire Arc Equipment Producers
Fig. 6-46	Chrome Replacement Thermal Spray Segmentation and Forecast, Consumables
Fig. 6-47	Chrome Replacement Thermal Spray Segmentation and Forecast, Equipment
Fig. 6-48	Forecast, Decorative Metallic Coatings Market
Fig. 6-49	Decorative Coating Market Segmentation and Forecast