



Semiconductor Materials Information

# Wet Chemicals

For Semiconductor Device Processing

## A Techcet Group Critical Materials Report

Prepared by

Lita Shon-Roy and

Michael A. Fury, Ph.D.

2011

\* [www.techcet.com](http://www.techcet.com)

[Lshonroy@techcet.com](mailto:Lshonroy@techcet.com)

Ph: 858-259-9077

**Acknowledgments**

**Wet Chemicals**

Copyright 2011 Techcet CA, LLC.

**Page 1 of 121**

#WetChemTOC2011LS

Thank you to all those that provided inputs for this year's report. Most of those that participated wished to remain anonymous. They included all major chemical suppliers in addition to large US end users. Other information obtained for this report was gleaned from industry conferences, technical experts, and literature in the public domain.

Readers Note: This report represents the interpretation and analysis of information generally available to the public or released by responsible agencies or individuals. Data was obtained from sources considered reliable. However, accuracy or completeness is not guaranteed.

## Table of Contents

	Page #
1 EXECUTIVE SUMMARY .....	7
1.1 Market .....	7
1.2 Suppliers and Regions .....	7
1.3 Supply Issues .....	8
1.4 Environmental, Health, and Safety .....	9
2 INTRODUCTION .....	10
2.1 Definition of Basic Wet Chemicals Bulk.....	10
2.2 Worldwide Chemicals Market.....	10
2.2.1 Growth in the US .....	14
2.2.2 China .....	15
2.2.3 The Middle East.....	16
3 MARKET RESULTS .....	18
3.1 Market Share by Region.....	19
3.2 US Wet Chemical Market Shares.....	20
3.3 Worldwide Wet Chemical Market Shares .....	20
4 SUPPLY CHAIN ISSUES .....	23
4.1 Hydrochloric Acid .....	23
4.2 Solvents and the Petrochemical Market .....	24
4.3 US Petroleum or Gas Availability .....	25
4.4 Phosphoric Acid and Phosphor Rock.....	30
4.4.1 Phosphor Rock Mining Outlook .....	32
4.4.2 Phosphoric Acid.....	32
4.4.3 Phosphoric Acid Supply Chain and Distribution.....	36
4.5 HF and the Fluorspar Supply Chain .....	37

4.5.1 HF Applications .....	37
4.5.2 Fluorspar Trade and Production.....	38
4.5.3 HF Pricing and China .....	39
5 WET CHEMICAL CLEANING TECHNOLOGY .....	43
5.1 Tool Configuration & Batch Size.....	44
5.2 Chemical Delivery .....	46
5.3 Mechanical Energy .....	48
5.4 Wafer Drying .....	49
5.5 Chemical Supply and Management.....	50
5.7 Future Trends in Wet Cleaning.....	51
5.8 Condensed Gas Alternatives.....	52
5.9 Other Alternatives.....	54
6 MAKERS AND SUPPLIERS .....	55
7 ENVIRONMENTAL, HEALTH AND SAFETY .....	57
7.4 REACH.....	57
7.5 Korea REACH-Like Program.....	58
7.6 World Semiconductor Council .....	58
7.7 Green House Gas Reporting Impact on US Businesses (this section also appears in Techcet's Electronic Gases Report) .....	61
8 COMPANY PROFILES AND NEWS.....	65
8.1 Air Liquide (supplier) .....	65
8.2 BASF.....	68
8.3 Bluestar New Chemical Material Co., Ltd.....	72
8.4 Dongwoo Fine Chemicals, Ltd. (Korea only) .....	74
8.5 Dow Chemical .....	76
8.6 Eastman Chemical Company .....	80
8.7 FujiFilm Electronic Materials.....	82
8.8 General Chemical Performance Products LLC (now owned by KMG) .....	85
8.9 Honeywell International Inc. ....	86
8.10 Israel Chemicals Ltd.....	89
8.11 KMG Chemicals Inc. (and General Chemical).....	91

8.12 Kanto Chemical Co., Inc.....	93
8.13 Mallinckrodt Baker, Inc. / Avantor.....	95
8.14 Mitsubishi Gas Chemical Group, Inc. ....	99
8.15 OM Group, Inc.....	103
8.16 Rudong Zhenfeng Yiyang Chemical Co., Ltd. ....	105
APPENDIX A: WET CHEM SUPPLIERS AND MAKERS UNABRIDGED, 2009.....	106
APPENDIX B: HOMELAND SECURITY CRITICAL INFRASTRUCTURE: CHEMICAL SECURITY .....	111

### List of Figures

	Page #
Figure 1: Biggest Operating Profit Winners and Losers .....	11
Figure 2: US GDP .....	14
Figure 3: Asian Country GDP Comparison.....	15
Figure 4: World Wide Acids, Bases and Solvents Revenues for ICs.....	18
Figure 2: Semiconductor Process Chemicals - Regional Market Share 2010 .....	19
Figure 5: US Petroleum Consumption and Dependence on Imports.....	25
Figure 6: US Natural Gas Production .....	28
Figure 7: Worldwide Spot Market Petroleum Price History.....	29
Figure 8: World Fertilizer use by Type.....	31
Figure 9: Phosphor Rock Production 2010.....	33
Figure 10: Phosphate Rock Processing to End Use Product .....	34
Figure 11: Worldwide Fluorspar Production 2010 .....	39
Figure 12: Fluorspar Pricing History FOB China .....	40
Figure 13: Fujifilm Operational Income by Regional.....	84
Figure 14: Fujifilm Regional Sales History.....	84

## List of Tables

	Page #
Table 1: Top 10 Worldwide Chemical Companies Growth Statistics 2010/2009.....	12
Table 2: Worldwide Chemical Industry Growth .....	13
Table 3: Middle Eastern Petroleum Projects .....	17
Table 4: Worldwide Acids, Bases and Solvents Revenues and Growth.....	18
Table 5: Wet Chemical Market Share Ranking - US .....	20
Table 6: Worldwide Wet Chemicals Market Ranking.....	21
Table 7: Semiconductor Wet Chemical Regional Market Leaders and Approximate Market Shares.....	22
Table 8: Wet Chemical Suppliers for Selected Chemicals .....	56
Table 9: Air Liquide Sales and Earnings .....	66
Table 10: BASF Sales and Earnings .....	70
Table 11: Sumitomo Sales and Earnings .....	75
Table 12: Dow Sales and Earnings .....	77
Table 13: Eastman Sales and Earnings .....	81
Table 14: FujiFilm Sales and Earnings.....	83
Table 15: Honeywell Sales and Earnings.....	87
Table 16: ICL-PP Sales and Earnings.....	90
Table 17: KMG Sales and Earnings .....	92
Table 18: Mitsubishi Sales and Earnings .....	100
Table 19: OM Group Sales and Earnings.....	104
Table A-1: Wet Chemical Suppliers, Purifiers, and Makers for Selected Chemicals .....	106