



Electronics Materials Information

2018

Wet Chemicals

For Semiconductor Manufacturing Applications

a TECHCET Critical Materials Report™

Prepared by

Yu Bibby, Ph.D.

Edited by T. Francis and L. Shon-Roy

TECHCET CA LLC
PO Box 3056
Rancho Santa Fe
San Diego County, CA 92067

www.techcet.com
[info@ techcet.com](mailto:info@techcet.com)
+1-480-382-8336

Table of Contents

	Page #
1 Scope, Purpose & Methodology	6
1.1 Definition of research scope & methodology	6
1.2 TECHCET 5-year wafer forecast.....	6
2 Executive Summary	8
2.1 Business Trends in Brief.....	8
2.2 Technology Trends in Brief	9
2.3 Wet Chemical Market Outlook with 5-Year CAGR Summary	10
2.4 Major Changes in Suppliers.....	11
2.5 Environmental, Health, and Safety Impacts	13
3 Market Outlook	16
3.1 Worldwide Semiconductor Industry Market Overview.....	16
3.2 Worldwide High Purity Electronic Wet Chemical Market Overview	19
3.2.1 Worldwide & Regional Market Rankings for Wet Chemical Suppliers.....	21
3.2.2 Worldwide Wet Chemicals Market Revenues	23
3.2.3 Challenges for Electronic Grade High Purity Wet Chemical Suppliers	25
3.3 Sulfuric Acid (H₂SO₄).....	27
3.3.1 Market Dynamics/Overview and Factors Driving Growth.....	27
3.3.2 TECHCET's Forecast	27
3.3.3 Market Leaders	28
3.3.4 Supply Chain Issues.....	29
3.4 Hydrogen Peroxide.....	31
3.4.1 Market Dynamics/Overview and Factors Driving Growth.....	31
3.4.2 TECHCET's Forecast	34
3.4.3 Market Leaders	34
3.4.4 Supply Chain Strategies.....	35
3.5 Phosphoric Acid (H₃PO₄).....	36
3.5.1 Market Dynamics/Overview and Factors Driving Growth.....	36
3.5.2 TECHCET's Forecast	36
3.5.3 Market Leaders	37
3.5.4 Supply Chain Issues.....	38
3.6 Hydrofluoric acid/ Buffered Oxide Etch (HF/BOE).....	47
3.6.1 Market Dynamics/Overview and Factors Driving Growth.....	47
3.6.2 TECHCET's Forecast	48
3.6.3 Market Leaders	49
3.6.4 Supply Chain Issues.....	49
3.7 Nitric Acid	57
3.7.1 Overview and Market Drivers.....	57
3.7.1 TECHCET's Forecast	58
3.7.2 Makers & Suppliers	59
3.7.3 Supply Chain Issues.....	59
3.8 Hydrochloric Acid (HCl)	61
3.8.1 Market Dynamics/Overview and Factors Driving Growth.....	61
3.8.2 TECHCET's Forecast	62

3.8.3	Market Leaders	63
3.8.4	Supply Chain Status	63
3.9	Isopropyl Alcohol (IPA) / Solvents	64
3.9.1	Market Dynamics/Overview and Factors Driving Growth	64
3.9.2	TECHCET's Forecast	64
3.9.3	Market Leaders	65
3.9.4	Supply Chain Issues	65
3.9.5	Market Dynamics/Overview and Factors Driving Growth	67
3.9.6	TECHCET's Forecast	69
3.9.7	Market Leaders	70
3.9.8	Supply Chain Issues	70
4	Environmental, Health and Safety	71
4.1	US Clean Air Act-Regulation Updates	71
4.2	Chemical Regulations TSCA Updates	72
4.2.1	OSHA to Align US Rules with Latest GHS	74
4.3	REACH.....	75
4.3.1	Europe REACH:	75
4.3.2	Korea, K-REACH	78
4.4	ROHS- Restriction of Hazardous Substances	79
4.5	EU, ROHS	79
4.6	Brazil, ROHS	80
4.7	China, ROHS₂ (non-EU).....	80
4.7.1	Ukraine ROHS-like Regulation	81
4.8	Japan's Chemical Substances Control Law (CSCL)	81
4.9	Kigali amendments / Montreal Protocol	83
5	Supplier Profiles	84
5.1	China Suppliers & Makers	84
5.1.1	JM (JiangyinJianghua Microelectronics Materials Co).....	84
5.1.2	Jiangyin Runma Electronic Material Co	85
5.1.3	Rudong Zhenfeng Yiyang Chemical Co., Ltd. (maker).....	86
5.1.4	Bluestar New Chemical Material Co., Ltd. (Maker and Supplier)	87
5.2	Air Liquide (Supplier).....	88
5.3	BASF (Maker, Purifier and Supplier).....	91
5.4	Dongwoo Fine Chemicals, Ltd. (Korea, Purifier& Supplier)	97
5.5	5-5 Dow Electronic Materials (Maker).....	101
5.6	Eastman Chemical Company (Maker).....	105
5.7	FUJIFILM Ultra Pure Solutions, Inc. (Maker, Purifier & Supplier).....	111
5.8	Honeywell International Inc. (Maker, Purifier & Supplier)	117
5.9	Israel Chemicals Ltd. (Maker)	125
5.10	Kanto Chemical Co., Inc. (Purifier & Supplier)	128
5.11	KMG Chemicals Inc. (Maker, Purifier & Supplier)	130
5.12	Avantor / Mallinckrodt Baker, Inc. (Purifier & Supplier).....	134
5.13	Mitsubishi Gas Chemical Group, Inc. (Maker & Supplier)	137
5.14	Peroxychem (Maker)	144
5.15	Solvay (Maker)	146
Appendix A: typical products specification for HF 49% from various manufacturers and suppliers.....	152	

Appendix B: New fluorspar projects around the world	155
Appendix C: Historical Information on TSCA	158

List of Figures

	Page #
Figure 1: Annual Wafer Starts for Various Technology Notes	7
Figure 2: Worldwide Semiconductor Revenues History	16
Figure 3: 2017 Semiconductor Annual Sale Growth by Regions	17
Figure 4: Q1 2018 Semiconductor Annual Sales Growth by Regions.....	18
Figure 5: Typical High Purity Chemicals Used in Semiconductor Fabs	20
Figure 6: WW Electronic Wet Chemicals Revenues & Growth.....	24
Figure 7: Materials Impact on Device Performance.....	25
Figure 8: Chemical Purity Required & Maintained at Each Steps of Supply Line	26
Figure 9: WW High Purity Sulfuric Acid Revenue & Growth Estimate (\$M's)	28
Figure 10: 2017 World Consumption of Sulfuric Acid	29
Figure 11: Sulfuric Acid Price Trend Index	30
Figure 12: Market Segments of Hydrogen Peroxide	32
Figure 13: WW Hydrogen Peroxide Revenues & Growth Estimate (\$M's)	34
Figure 14: WW High Purity Phosphoric Acid Revenues & growth Estimate (\$M's).....	37
Figure 15: Worldwide Usage of Phosphoric Acid.....	38
Figure 16: China's Current Rare Earth Materials Resource Tax.....	41
Figure 17: 2017 Worldwide Phosphor Rock Production	42
Figure 18: 2017 World Phosphoric Rock Reserves	44
Figure 19: Phosphor Rock Price Trends.....	45
Figure 20: Phosphoric Acid Price Trend Index.....	46
Figure 21: WW HF/BOE Revenues Estimate (\$M's)	49
Figure 22: 2017 Worldwide Fluorspar Productions	53
Figure 23: 2017 Worldwide Fluorspar Reserves	54
Figure 24: Acid-Spar Price History and Future Trend	56
Figure 25 WW Nitric Acid Revenues & Growth Estimate (\$M's).....	59
Figure 26: Worldwide Consumption of Nitric Acid	60
Figure 27: The World Consumption of Hydrochloric Acid	62
Figure 28: WW Hydrochloric Acid Revenues & Growth Estimate (\$M's)	63
Figure 29: WW IPA/Solvents Revenues & Growth Estimate (\$M's)	65
Figure 30: Worldwide Spot Market Petroleum Price History.....	67
Figure 32: Typical Aluminum Etchant Formulas.....	68
Figure 33: Typical Aluminum Etching Rate Variations with Temperature	69
Figure 34: Aluminum Etch Market	70
Figure 35: EU REACH compliance registration deadlines.....	77

Figure 36: FujiFilm Earnings from Electronic Materials/Fine Chemical Segment	117
Figure 37: J.T.Baker® Products Carried by Avantor.....	135
Figure 38: Typical Specifications for Hydrofluoric Acid, 49%	152

List of Tables

	Page #
Table 1: Worldwide (WW) High Purity Wet Chemicals Market Ranking	22
Table 2: Semiconductor Wet Chemical Regional Market Leaders & Market Shares	23
Table 3: Annual Production of Phosphoric Acid by Region	39
Table 4: JJM Product Listing	85
Table 5: Runma Product Listing	86
Table 6: Air Liquide Sales and Earnings	89
Table 7: BASF Growth in Key Customer Industry and By Region	93
Table 8: BASF Sales and Earnings.....	93
Table 9: Dow Sales and Earnings	104
Table 10: 2017 DowDuPont Electronics & Imaging Division Earnings	104
Table 11: 2017 DowDuPont Each Business Segment Sales	105
Table 12: Eastman Sales and Earnings.....	111
Table 13: FUJIFILM Electronic Materials Products List.....	114
Table 14: 2017 Fujifilm Sales and Earning	116
Table 15: Honeywell Cleaning Chemistries Mixtures.....	119
Table 16: Honeywell sales for 2018 1 st quarter	121
Table 17: Honeywell Sales and Earnings	125
Table 18: ICL Performance Products Group (ICL-PP) Sales and Earnings.....	127
Table 19: Kanto's Ultra Pure Chemicals Products List.....	130
Table 20: KMG Sales and Earnings.....	133
Table 21: KMG Products Lists	133
Table 22: Mitsubishi Products List	138
Table 23: Mitsubishi Sales and Earnings	143
Table 24: Solvay Business Structure with three Operating Segments	146
Table 25: Solvay's M&A Activities.....	147
Table 26: Solvay Sales and Earnings	151