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Date: February 2, 2024
To: Dale Keeler - Materials Technology Institute
From: Gary Van Schooneveld
Subject: MTI Project 411 Extractables in Polymers
Reference: MTI 2211 5387

Objective:	• Quantify the increase and determine the nature of contamination resulting from the conversion of PFA and PVDF pellets into high-purity sheet material. • Identify potential sources of contamination and provide recommendations for potential improvements in the conversion process.
Details:	• SEMI specifications will be the basis for the analytical methodologies. o *SEMI F57-0622, Specification for High Purity Polymer Materials and Components Used in Ultrapure Water and Liquid Chemical Distribution Systems*, will be used to determine the area-normalized contamination (trace metals, anion including ammonium and TOC) extracted in hot ultrapure water (UPW). o *SEMI C90-2015, Test Method and Specification for Testing Perfluoroalkoxy (PFA) Materials Used in Liquid Chemical Distribution Systems* will be used to determine the area-normalized trace metal contamination extracted in 5% nitric acid. *(Note - There will be one exception recommended for the SEMI C90 test. This exception will be that the leach condition for the extruded sheet and pellets will be identical, that is, each will be conditioned for 24 hours at ambient temperature. This is a change from SEMI C90; the specification calls for pellets to be extracted at 70°C for 4 hours.)* o *SEMI F40-0621E, Practice for Preparing Liquid Chemical Distribution Components and Neat Polymers for Chemical Testing* will be used for sample preparations. • For this proposal, the raw materials and extruded sheets will be per the table in the RFQ and shown below (Table 1). It is understood that this table may change if some sheet converters are unable to support this project.

Table 1. Test Matrix

					Resin		Sheet	
Materials for Test	**Material**	**Resin**	**Resin Mfg**	**Sheet Converter**	**SEMI F57**	**SEMI C90**	**SEMI F57**	**SEMI C90**
PFA 1 - Chemours/Agru	PFA 450	PFA	Chemours	AGRU	3	3	3	3
PFA 2 - Chemours/Allied Supreme	PFA 451	PFA	Chemours	Allied Supreme	3	3	3	3
PVDF 1 - Arkema/Simona	Kynar 740	PVDF	Arkema	Simona	3	3	3	3
PVDF 2 - Solvay/Agru	Solef 1010	PVDF	Solvay	AGRU	3	3	3	3

- CT Associates (CTA) will use Balazs Nanoanalysis for the analytical preparations per SEMI F40 and extractions per SEMI F57 and C90.
    - The Balazs Fremont, California facility will conduct the SEMI F57 extractions.
    - The Balazs Dallas, Texas facility will conduct the SEMI C90 extractions.
    - CTA will organize and coordinate all sample collections, both for pellets and sheet materials and their delivery to Balazs.
    - CTA will issue and manage all purchase orders with Balazs.
    - CTA will work with Balazs on clean sample preparation, particularly for sheet samples, to minimize contamination from the sample preparation. At this time, the most likely candidates for sheet coupon preparation are ceramic scissors for PFA and low-temp fracturing for PVDF.

- The data generated from the SEMI F57 and C90 testing will be organized along with material and converter supplied data. These data will be reviewed to establish correlation and patterns between raw materials, handling and manufacturing protocols and final extruded sheet contamination.

- A final report will be prepared with the following minimum content:
    - Results from the SEMI F57 and SEMI C90 analyses.
    - Vendor supplier data
    - Interpretation of the extraction results relative to:
        - changes between pellet contamination levels and finished,
        - identification of potential sources of increased contamination levels and
        - recommendations for contamination reduction.

	○ Recommendations for test method improvements (sampling and sample preparations). ○ Recommendations for next steps • All data will be presented anonymously relative to pellet provider and sheet converter. • CTA is open and willing to sign mutual non-disclosure agreements with material and converters as required.
Personnel:	Gary Van Schooneveld will the principal investigator on this project. Gary Van Schooneveld is President of CT Associates, Inc. Gary has over 30 years of semiconductor experience with high-purity fluid systems including chemical delivery and ultrapure water and the development and testing of their associated materials and components. Gary is presently Co-chair of the IRDS Critical Components Task Force and Co-chair of the SEMI UPW Task Force. He is also an active member of the SEMI High-Purity Polymer Task Force that recently completed the latest revision of SEMI C90 (out for voting) and SEMI F57++ (in process). He has run three semiconductor industry sponsored (IRDS) contamination studies in the areas of contamination in UPW water systems and extraction of particles and particle precursors from PFA and PVDF in hot UPW. He is presently the principal investigator on the SEMI C79 sponsored project to develop a particle precursor challenge for filters used in UPW below 15 nm. He is the author or co-author of more than 50 technical papers and presentations. Gary has BS and MS degrees in Materials Engineering from Rensselaer Polytechnic Institute (Troy, NY) and an MBA from the University of Texas (Arlington, TX).
Duration:	• Test planning and preparations – 4 weeks from go-ahead • Sample collection (pellets and sheet) – to be determined. • SEMI F57 and C90 analysis – 4 weeks after receiving all the test samples. • Analysis and final report – 4 weeks after completion of the SEMI F57 and C90 analyses.
Cost	• Time and materials basis • Projected costs: • There are no costs included for travel and all presentations and meetings are assumed to be virtual.
Terms	• Net 30 days for analytical upon receipt of test data from Balazs.

	• Net 30 days for program management feed upon submittal of the final report. • Quote valid for 180 days