[0004] Existing cylindrical filter modules suffer several shortcomings. One deficiency is that the circular pleated membrane unduly restricts fluid flow because the membrane must be more tightly packed towards the center in order to achieve the circular configuration. Another deficiency is that the cylindrical housings are molded or extruded as single pieces, making it difficult or impossible to add geometries that run perpendicular to the cylinder's axis. Furthermore, many existing filter modules are difficult to install and replace. Since many liquids used in semiconductor manufacturing are corrosive or toxic, filter module replacement presents a danger to workers.

[0005] Current filtration systems that employ cylindrical filters have limited configurability. In many cases, filters are connected through multiple units in a fixed configuration, making it difficult to change the flow through the filters from serial to parallel as needed. Additionally, many filtration systems use only a single type of filter, limiting the ability to apply different filters for different purposes or particle sizes in a single filtration system.

SUMMARY

[0006] Embodiments of modular purification systems and methods are described. According to one embodiment, a purification system can comprise a generally rectangular removable purifier cassette and a manifold assembly. The manifold assembly may comprise a plurality of connection systems to connect to the purifier cassette.

[0007] ~~In one embodiment,~~According to a first aspect of the present invention, there is provided a purification system comprising a generally rectangular removable purifier cassette, the purifier cassette comprises a ~~main~~purifier body having a first sidewall, a second sidewall, a third sidewall and a fourth sidewall and may define a media cavity. The first sidewall is opposite the second sidewall and the third sidewall opposite the fourth sidewall. One or more tension members coupled to the first sidewall and the second sidewall of the media cavity, the one or more tension members dividing the media cavity into a plurality of sections; a purifier element disposed in each of the plurality of sections; a first purifier port fitting providing a first purifier port fluidly connected to an upstream portion of the media cavity; a second purifier port fitting providing a second purifier port fluidly connected to a downstream portion of the media cavity; a manifold assembly into which rectangular filter cassettes can be inserted and from the rectangular filter cassette can be removed for replacement, the manifold assembly comprising a plurality of connection systems providing manifold ports, the manifold ports comprising: a first manifold port coupled to the first purifier port fitting; a second manifold port coupled to the second purifier port fitting; wherein the manifold assembly is configured to receive the removable filter cassette through horizontal translation

through a front side of the manifold assembly and adapted to allow an operator to seal/unseal the purifier cassette from the front side of the manifold assembly and wherein the rectangular removable purifier cassette is adapted to be inserted and removed from the manifold assembly through horizontal translation through the front side of the manifold assembly. The purifier cassette may include a number of ports including a first purifier port fluidly connected to a first portion of the media cavity and a second purifier port connected to a second portion of the media cavity. The first and second portion of the media cavity may be separated from each other by one or more purification elements. One or more tension members may be coupled to the first sidewall and the second sidewall of the media cavity, the tension members dividing the media cavity into a plurality of sections.

[0008] The purifier body can be configured with reinforcing structures. According to one embodiment, the reinforcing structures comprise reinforcing ribs extending the length of the device (or other length) that can provide, in one embodiment, the dual functions of providing flow paths and reinforcing the main body. The reinforcing ribs may define arced, elliptical or otherwise rounded flow paths, thereby providing reinforcing arches. Thus, according to one embodiment, a series of reinforcing arches can define the flow paths along the sidewall.

some cases, the connection systems are configured to allow a user to seal rear ports of a purifier cassette from a front side of the purifier cassette. The plurality of connection systems may be coupled to a main manifold plate. One or more of the connection system may be movable or fixed. Thus for example, a first connection system may be movable relative to the main manifold plate and a second connection system may be fixed.

[0014a] According to a second aspect of the present invention, there is provided a manifold assembly for receiving a purifier cassette having a plurality of port fittings, the manifold assembly comprising: a first connection system comprising: a first connection housing defining a first opening; a first manifold fitting; and a first connection nut disposed in the first connection housing first opening and rotatable in the first connection housing around the first manifold fitting, the first connection nut comprising a set of first connection nut internal threads, the first connection nut internal threads configured to engage first port fitting external threads of the cassette to create a seal between first port fitting and first manifold fitting with less than 360 degrees of rotation of the first connection nut; and a second connection system spaced from the first connection system, the second connection system configured to engage at least one additional port fitting on the cassette.

[0015] A connection system may comprise a connection housing defining a connection housing opening, a manifold fitting and a connection nut disposed in the connection housing opening. The connection nut can include a set of connection nut internal threads. The connection nut internal threads may engage the first purifier port fitting external threads. The connection nut internal threads can be configured to create a seal between the first purifier port fitting and manifold fitting with less than 360 degrees of rotation of the connection nut. In some embodiments, less than 360 degrees of rotation may result in at least 360 degrees or more of thread engagement and in other embodiments may result in less than the 360 degrees of thread engagement. The thread engagement may provide a circumferential axial sealing force sufficient to seal the first purifier port fitting to the first manifold fitting. In one embodiment, the connection nut internal threads and first purifier port fitting external threads are multi-start threads.

[0016] The connection nut may further comprise external threads that engage with connection housing inner threads and may be configured to inhibit backing out of the connection nut under the axial loading. According to another embodiment, the connection nut does not include external nut threads, but is retained in the connection housing from moving axially while still being able to rotate.

[0017] The manifold assembly may also include a second connection nut disposed in the same housing or a different housing than the first connection nut. Thus, for example, the second connection nut may be disposed in a second opening in the first connection housing or in an opening in a second connection housing. The second connection nut can include external threads to engage a set of second connection housing inner threads (or may not include external threads). According to one embodiment, the second connection nut may be operatively coupled to the first connection nut so that the first and second connection nuts rotate simultaneously. For example, the purification system can comprise a gear assembly operatively coupling a first connection nut to a second connection nut such that the first connection nut and second connection nut rotate simultaneously. The second connection nut may seal a second purifier port fitting to a second manifold fitting with less than 360 degrees of rotation of the second connection nut.