I understand why one doesn't want wires to burn up, but why aren't breakers used to protect components as well?

Because they aren't designed to do that job.

Circuit breakers like the ones in our homes or on our FRC robots are designed for wiring. They react somewhat slowly and actually allow over-current that would fry electronic components, for a given period of time based on how long standard wiring will take to dangerously heat up. They react faster as the current surges higher, but still are only trying to avoid wire meltdown.

Home circuit breakers are designed to prevent fires inside your walls, not to protect your (*insert random manufacturer here*) refrigerator/microwave combo. Breakers are designed only knowing that a random number of devices of unknown characteristics will use the wiring they protect over a period of many years. Many of the devices that they will eventually provide power to haven't even been thought of yet.

When your home breaker blows because the microwave, toaster, and hair dryer were all on at the same time, it’s not because any device was in danger, but because the combined power draw did endanger your home wiring. A short in your toaster will trip the breaker, but that’s only after the device (toaster) has already failed (and shorted). There are also specially designed ground-fault interrupter breakers for use around sinks and tubs. These are not designed to protect house wiring per se, but to protect against fatal electrocution from short circuits and trip much faster for when your toaster falls into the sink, but the toaster itself is already “toast” even when those blow.

Instead, our home appliances all have their own individualized protection designed in. They all have to watch out for themselves, because only they know what their design limitations are.

For instance, electronics require custom protection with much faster response to protect delicate circuitry, with no over-current allowed at all. Window motors, on the other hand, only worry about slower heat buildup, so different devices require different protection solutions to be designed in.
The internal PTCs and special fuses in our electronics react very fast, at speeds required to save that particular circuit design and the more delicate electronic components.
Our window motors have thermal protection built-in to avoid meltdown in the motor, because it's a buildup of heat instead of high current that's the problem being solved. A CIM solves the heat buildup problem with more mass that absorbs much more heat and heavier gauge motor windings, instead of a thermal switch.

It all comes down to what each breaker, wire, electronic component is designed and rated to handle.
In this case, our circuit breakers have amp ratings and response times that are matched to standard wire gauges. Those amp ratings can be used to determine how many home appliances or robot devices can be supported on a single circuit, but they are not matched to protect each individual electrical component on that circuit.

With enough variety in fuse/breaker values to choose from we can approximate custom circuit protection. A good example this season was the Tetrix motor and the battery with it's 20a fuse. The 20a fuse protected the wiring from over-current drawn from the battery, not the smoking motors. We could compensate by substituting a much lower rated fuse, however, we'd have to change the fuse rating based on how many motors we had on that circuit, essentially custom selecting a fuse to match our application, and it was a suboptimal solution because it would burn out over time or trip earlier than necessary anyway.